

SETTING OUT CHROME-TANNED LEATHER.

Frontispiece

PRACTICAL TANNING:

A HANDBOOK

OF

MODERN PROCESSES, RECEIPTS, AND
SUGGESTIONS

FOR THE

TREATMENT OF HIDES, SKINS AND PELTS
OF EVERY DESCRIPTION,

INCLUDING

VARIOUS PATENTS RELATING TO TANNING, WITH SPECIFICATIONS.

BY

LOUIS A. FLEMMING,
AMERICAN TANNER.

SECOND EDITION, IN GREAT PART RE-WRITTEN, THOROUGHLY REVISED AND MUCH ENLARGED.

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PREFACE TO THE SECOND EDITION.

IN presenting to the Leather Industry and to the dealers in, and the consumers and inspectors of, hides, skins, pelts and leather, as well as to the dyers of leather, this new, revised, enlarged, and systematically arranged edition of his PRACTICAL TANNING, the author has this to say, for himself and for his book :

Like its predecessor, this volume embraces the results of his own experience, his study and research, and the experiences of the many practical men with whom it has been his good fortune to come into association and consultation ; and the book has been so carefully and thoroughly revised throughout, as practically to be considered as having been rewritten. Nothing whatever has been incorporated into it that has previously appeared in any American or English book—his own alone excepted—and it is intended to present the newest and best American practice of this now great and progressive industry. He has diligently consulted the leading American trade papers and where it has been found possible, in the text, given due credit ; but he would here acknowledge his special obligations to *The Shoe and Leather Reporter*.

This volume is, as its title implies, essentially a practical treatise, and the details of that practice are given with such clearness and precision, such absence of confusing technicalities, as is believed to demand nothing more. As a typical illustration of this thoroughness, the author would refer to the section devoted to Sheepskins. There will be found complete directions for handling these skins from the time they are received by the tanner or the wool-puller until they are turned out as finished leather.

In the Appendix will be found descriptions of various processes of tanning, unhairing, coloring and finishing skins and leather that have been recently patented by their inventors. These processes are given, not with the idea of advertising or recommending them, but rather to enable the reader to learn of processes that are a little out of the ordinary practice ; in which new materials are used or old ones employed

in new ways. Some of these processes are undoubtedly of value, while the value of others may be questioned. However, to read them, one and all, will, it is believed, add to the tanner's knowledge of his art.

The first edition of PRACTICAL TANNING having been received by the trade with such distinct favor, as well abroad as at home, it is believed that this one, so great an advance in value over its predecessor, must also prove a further help to the tanner, and a marked success generally.

In conclusion he would state that the volume has been supplied with such a full table of contents, and such an exhaustive index as to render references to any subject or detail in it prompt, easy and satisfactory.

L. A. F.

HILLSDALE, MICHIGAN, *April 4, 1910.*

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PRACTICAL TANNING.

SECTION ONE.

THE MANUFACTURE OF SIDE LEATHERS.

Soaking Green-salted Hides.—It does not matter in what condition hides are received, nor the kind of leather into which they are to be made, they require soaking and softening in water as a preliminary and preparatory process before any attempt is made at tanning them.

The hides are first trimmed, the tails, shanks and pates being cut off in the hide cellar; then they are soaked. The most approved method of soaking is to hang the hides in the water, which should be clean and soft. If the water is hard, five pounds of borax dissolved in hot water should be stirred into it to make it softer and to increase its softening and cleansing power. The hides should be hung in the water, from tail to head, and left therein for twenty-four hours. They should then be taken out and split into halves or sides, the water in the soak-vat run off, fresh water run in, and the hides put back and soaked twenty-four hours longer. Splitting into sides can also be done after the second soaking.

* The object of the soaking process is to soften the hides and to remove from them the salt, dirt and blood that adhere to them. While the hides must be thoroughly softened, they must not be allowed to become flaccid. As the soaking process comes at the beginning of leather-making processes, it is a matter of much importance that the hides are thoroughly cleansed and softened in order that they may be worked the more satisfactorily through the processes that follow.

Salted hides, when they are soaked too long, lose gelatine, and this results in loose and spongy leather. On the other hand, if they are not soaked enough to accomplish the objects aimed at, they do not go into the lime in the right condition, and the grain has serious defects. The water should be changed once or twice during the process. If the hides are very dirty and salty, two changes are necessary; if only ordinarily salty and dirty, one change is sufficient. The changing of the water hastens the softening and makes the hides cleaner. Hides soaked in hard water absorb the water readily, and hence become soft in a short time. It is claimed, however, that hard water containing the salts of lime and magnesia tends to affect the substance of the hides. It is well known that different results are obtained in tanneries from the use of different kinds of water, but it is always safe to use clean, soft water. Hard water is softened by the addition of borax or sulphide of sodium.

Usually hides are sufficiently soaked by being suspended in the water twenty-four hours, then removed and resoaked in fresh water for another twenty-four hours. No exact rule can be given, however, as much depends upon the thickness and condition of the hides and the temperature of the water. It is important that all blood, dirt and salt be gotten rid of in the soaks. These substances, especially the blood, dirt and refuse, soon putrefy in water, the putrefaction readily injuring the hides. For this reason and also because of the unpleasant odor, it is not good practice for a tanner to use water over and over again for successive lots of hides. Old, stale water certainly softens hides in a short time, but usually at the expense of some desirable quality of the leather. Sometimes the defects that result from careless soaking are not noticed until after the leather is tanned, and then no one can tell what caused them, and the blame is laid to improper treatment in some other portion of the work. Pricked and pitted grain are among the effects of careless soaking. The former is in appearance similar to what would be the effect of puncturing the grain with

pins. This is caused by soaking hides too long, especially in hot weather. Pitted grain is similar to pricked grain, only the holes are larger. The hides begin to decompose before they are taken out of the water, and no subsequent treatment can remedy the defect.

The hides for sole, upper, harness and other kinds of leather are soaked alike. At the end of the soaking process the hides are removed from the water, drained, split into sides if not already in sides, fleshed, pinned together into a chain and passed into lime.

Soaking Dry Hides.—This class of hides require longer soaking and thorough working to get them into the soft, pliable condition that is required before they can be fleshed and limed. The following method of soaking dry hides is as good as any that can be used: For every hundred gallons of water in the vat, dissolve twelve ounces of sulphide of sodium in hot water and pour the solution into the water, plunging thoroughly. Put the hides into the water and let them soak twenty-four hours. If the water is soft, less sulphide may be used. At the end of twenty-four hours, take the hides out of the water, put them into a dry mill and run them in it thirty or forty minutes; then place them in a pile or piles, cover them up and let them lie twenty-four hours; then put them back into the same water in which they were soaked before and let them soak twenty-four hours. From this soaking run the hides in a dry mill one-half hour and then flesh them. After fleshing put them into clean cold water over night, then lime them. The hides should be split into sides before they are run in the mill.

Another good way to soften dry hides is to put them into a strong salt solution. In this the hides may remain three or four days or until they are flexible; they may then be worked in a hide mill or drum and resoaked in salt water until they are soft. Before the hides are limed, the salt should be gotten rid of either by soaking or washing in clean cold water.

Sun-dried hides should be unhaired with sulphide of sodium as it swells the fibers and freshens up the withered grain more

than lime alone does or lime and red arsenic. Owing to the difficulties encountered in softening dry hides, many tanners neglect this class of stock. And yet when the hides are properly soaked and unhaired with sulphide of sodium, very nice leather can be made from them. No class of hides requires more thorough treatment than dry hides. Having been dried in the raw state, they are almost waterproof, and as they are thick and heavy they are softened with considerable difficulty. Frequently, too, before the hides were dry, decay set in, which, although not noticed in the dry hide, becomes apparent when the affected hide is soaked. Then every spot that was not perfectly cured or that was tainted with decay will appear either by the hair coming off, the grain peeling, or by portions of the hide rotting away.

Soaking with sulphide of sodium, supplemented by working in a dry mill will be found to be the most satisfactory process that can be used on dry hides for upper harness and sole leather.

METHODS OF LIMING.

Liming for Upper Leather.—Green-salted hides intended for soft, supple leather, chrome or vegetable tanned, worked through a liming process as described below will be found to be sufficiently limed for unhairing in six days. Exact quantities of lime and sulphide of sodium can be used, namely, eight pounds of lime and one and one-half pounds of sulphide of sodium for every hundred pounds of hides.

To start the liming process, slake one and one-half pounds of lime and add it to the water in the vat; and plunge up well. Reel the chain of sides into the prepared lime, taking care that each side is spread out flat and not rolled or twisted. After the hides have been in the lime twenty-four hours, reel them into the second lime, made by slaking one and one-half pounds of lime for every hundred pounds of hides and adding it to water in a vat; leave the hides in this lime twenty-four hours. Then make up the third lime with the same quantity of lime as the second lime and allow the hides to remain in it twenty-four

hours. Reel them into the fourth lime, which should also contain one and one-half pounds of lime, and leave them in it twenty-four hours. The fifth lime should contain one pound of lime and the hides should remain in it twenty-four hours, then be reeled into the sixth lime which should contain one pound of lime and one and one-half pounds of sulphide of sodium. This lime should be warmed to 75 degrees Fah.; and the hides should be left in it twenty-four hours, then reeled into warm water, and after two or three hours unhaired. The position of the hides should be changed every day; and fresh lime should be used every day, the hides remaining in each lime twenty-four hours.

After the hides are unhaired, wash them for fifteen minutes in a wash-wheel with running water, then place them in warm water and work them over the beam and then bate them. The above-described process produces very uniform leather. The sulphide of sodium in the last lime helps to remove the fine hair, as it is very essential that leather finished on the grain be free from fine hair. By using definite quantities of lime and sulphide for definite quantities of hides it is a comparatively easy matter to have the packs run uniform. The hair should come off easily and clean. Unhairing out of new lime gives hard, plump hides, a condition that is desirable for chrome tannage and for splitting out of lime. The hides, after unhairing, can be split, or they can be bated and pickled and then split or bated, pickled and tanned and split after they are tanned.

Although eight pounds of lime will unhair one hundred pounds of hides, softer and more supple leather is obtained by using ten pounds in six limes, starting with a pound and a half and using two pounds each day until the hides reach the fifth lime, which should contain two and one-half pounds of lime and one pound of sulphide of sodium. Either of these processes will produce satisfactory results for chrome or vegetable tanning.

If the hides are to be split out of lime, they should be un-

haired, put into warm water and worked by hand over the beam, then put in cold water over night to harden for splitting.

Sulphide of Sodium Process.—Excellent results are secured by immersing hides in a solution of sulphide of sodium for three days and then liming them for two or three days. While this is a good process for both green-salted and dry hides, it is especially suitable for the latter, as it plumps and freshens them more than any other process does. A strong sulphide solution is made by boiling sulphide of sodium in a barrel and letting it stand until the next day to settle. The sediment should be discarded and only the clear liquor used. Sufficient water is run into a vat and enough of the dissolved sulphide is added to make a six-degree liquor. After the liquor has been thoroughly plunged and stirred, the hides are put in and left in for twenty-four hours. They should then be hauled out, the liquor plunged up and the hides put back for twenty-four hours. To hang the hides in the liquor is better than to simply throw them in. At the end of the second twenty-four hours the hides should be hauled out, the liquor plunged up and the hides put back again for twenty-four hours longer. If dry hides are being treated a little stronger liquor may be used after the first twenty-four hours than on green hides. Six degrees barkometer is the strength for green hides. Three days in the liquor is generally sufficient time to accomplish the results of the process, but very heavy and dry hides may be left in a day or two longer.

The hides should next be washed in a wash-mill with running water for thirty minutes; then put into lime liquor. Two pecks of lime should be used for one hundred average sides. It should be thoroughly slaked, added to the water and plunged. The sides should then be put into the liquor and left therein two days, being handled twice during that time. The lime is used to remove the sulphide from the hides.

When the hides have been in the liquor two days they should be washed for twenty minutes in cold water, bated and pickled. Bating is done most effectively with sour glucose and lactic

acid. The hides should be freed of all the sulphide of sodium before they are pickled and tanned. If preferred, splitting can be done out of the lime.

This process destroys the hair but makes very plump and tough leather, which is compensation for the loss of the hair. Dry hides that are not thoroughly softened in the soaks, when put through this process are plumped, softened and freshened in a very satisfactory manner. The workmen who handle the hides through the sulphide process must wear rubber gloves to protect their hands from the caustic material.

Patented depilatory crystals can be used in place of sulphide of sodium.

If the hides are split out of the lime the grains are then bated, pickled and tanned; if they are split out of pickle or after tanning they are bated whole and then pickled. Opinions differ in regard to the best time for splitting. Personally the author considers splitting out of alumina and salt pickle the best method, but many good tanners prefer to split out of acid pickle and others out of lime.

METHODS OF BATING.

Bating with Lactic Acid.—A slow, mild fermentation of an acid rather than a putrefactive nature, appears to be the ideal condition to be sought after; and this can be satisfactorily obtained by allowing grape sugar or common glucose to sour and using definite portions of this sugar in combination with lactic acid on each pack of hides.

1. The process is a simple one and is easily carried out in the following manner: Take one hundred pounds of grape sugar or glucose and dissolve it in thirty-five gallons of hot water in a barrel. Allow this to stand for two days in a warm temperature, when it will be completely soured. Prepare a paddle wheel with water at a temperature of 95 degrees Fahr., and put into it two and one-half quarts of the sour sugar solution. For every one hundred pounds weight of stock to be bated, take one pint of lactic acid and put about half of this

into the paddle wheel before putting in the hides. When the hides are in, add the rest of the lactic acid slowly. Three to four hours is usually sufficiently long to run the goods in the paddle wheel. On being taken out, the goods should be thoroughly washed with water. The importance of this simple washing is too often overlooked and the necessity of it cannot be over-emphasized, if a good clear grain which will color evenly is desired.

For the second pack of hides, the bate liquor is run down about twelve inches in the paddle wheel and the loss made up with fresh water. The temperature is brought up to 95 degrees, two and one-half quarts of the sour sugar solution is added and one pint of lactic acid for every hundred pounds of stock is taken as described on the first pack. Continue in this way, running off a little of the liquor for each pack, for six days, then run off all the liquor but retaining about a barrel full with which to mallow the new liquor, which is prepared with fresh water.

It should be pointed out that the amount of sugar solution used, namely, two and one-half quarts per pack, is based upon the volume of the liquor in the paddle wheel. The average capacity of a paddle wheel is between two thousand and twenty-five hundred pounds of stock. The fermentative action of the sugar is, however, so mild that a wide range in the weight of the stock bated with the given quantity of the sour solution is permitted without any danger.

2. *Another Method.*—Another and simpler method of introducing the fermentation into the bate is the following: Prepare a paddle wheel with water at a temperature of 120 degrees Fahr., put into it two pails full of dry bran and allow it to stand over night. Next day bring the temperature up to 95 degrees, and take one pint of lactic acid for every hundred pounds of stock and put about half of it into the bate liquor, then throw in the hides, and add the remainder of the acid slowly afterwards. Run the paddle for three or four hours, then take out the hides and wash them well. For the second

pack run the bate liquor down about twelve inches and make up the loss with fresh water, bring up the temperature to 95 degrees Fahr., do not use any more bran but take one pint of lactic acid for every hundred pounds of stock and proceed exactly as described on the first pack. Continue in this way for six days, then run off all the bate liquor and make up a fresh liquor with water at 120 degrees Fahr., and two pails of dry bran, allow same to stand at least twelve hours and then proceed in the manner described.

Either of these combinations has been found very satisfactory in the manufacture of side leather; and with very little practice uniform results are obtained. Where full flanks, "good break," and fine even grain are desired these processes can be recommended.

Inasmuch as they aim at definite proportions of definite materials to the weight of the stock to be bated, they represent a distinct advance in the progress of leather manufacture in a department where rule-of-thumb methods and a good deal of guesswork have prevailed from time immemorial.

The writer is indebted to *The Shoe and Leather Reporter* for the description of these processes. He has, however, used them in an experimental way and achieved perfectly satisfactory results from their use.

3. When lactic acid is used alone a little less than one pint of it is used for every hundred pounds of grains that have been carefully washed after fine-hairing. The acid is added to water at 95 degrees Fahr. and well plunged, then the grains are put in and processed for two or three hours, then taken out, washed, pickled and tanned.

Sides that have not been split should be given more acid and be left two or three times as long in the bath as the grains of hides split out of lime.

No matter what process of bating is used the hides should be washed in warm water afterwards and then pickled either with sulphuric acid and salt, or sulphate of alumina and salt.

Bating with a Bacterial Bate.—Because of the thorough

manner in which they rid hides of lime and sulphide of sodium or red arsenic, and because of the fine, silky, elastic grain and fineness of feel and texture that they produce, bacterial bates are in common use by the tanner of chrome and vegetable tanned side leathers. Dog, hen and pigeon manures are the materials in most general use. There are also bacterial bates on the market that the tanner can buy. They are much more cleanly to use than manures and more uniform in their action. Directions for these commercial bates are furnished by the manufacturers so they need not be given here.

Bating with chicken manure is done in the following manner: The manure is put to soak in hot water in a tub or barrel several days before it is used; and it should be stirred every day while it is soaking so that it will be made into a mash that can be strained. The water into which the manure is put should be about 150 degrees Fahr. temperature, but the mixture should not be boiled. Before it is used the bate material should be strained to rid it of objectionable foreign matter, such as cinders, gravel, feathers, etc.

A paddle vat is better for the process than a vat without paddles. Sufficient water should be run in and warmed up to 90 degrees Fahr. For grains that have been washed, use three pails of the strained manure for one hundred grains; for whole or unsplit sides use five pails.

Stir the material thoroughly through the water, and throw the hides in as quickly as possible so as to retain the heat. Run the paddle thirty minutes for split hides and then allow them to rest two hours, then run them for another half-hour, at the end of which time the stock should be soft and thin and ready to come out. The paddles can also be run one hour, then allowed to rest an hour, and then run thirty minutes, rested thirty minutes, then run ten minutes, when the hides should be sufficiently bated.

Whole sides should be paddled one hour, then allowed to rest two hours, and then paddled an hour longer and should then be ready to come out. No hard-and-fast rule can be laid.

down for this process as so much depends upon the condition of the hides, some of which bate more rapidly than others. Some grains bate sufficiently in two hours while others require more time. The paddle vat should be so constructed that the liquor can be warmed while the hides are in it, by having a steam-pipe surrounded by a box with holes in it at one end. The paddle should be covered and have a door in the front end which can be raised while the hides are being put in or taken out. A covered vat enables a uniform temperature to be maintained during the process.

The bating can be done during the night by putting the hides in and running the paddle an hour before closing time. The next morning the paddle should be run one hour, and if the hides do not appear to be bated the liquor may be warmed to 90 degrees Fahr. and a little more bating material added. After the hides are soft and low, and as soon as they are in this condition they should be taken out, washed in warm water, or in warm water containing a little lactic acid, for ten minutes if split, and thirty minutes if not split, and then drained preparatory to pickling or tanning.

THE PICKLING PROCESS.

Pickling with sulphuric acid and salt may be done in a paddle-wheel or in a drum. If the former is used dissolve forty pounds of salt for every hundred gallons of water in the vat; then for every hundred pounds of hides add to the salt water ten pounds of salt and one and one-half pounds of sulphuric acid. Plunge the liquor thoroughly and put the hides in. Run the paddle for two hours if the hides are split and then take the hides out and place them over horses to drain.

If the hides are not split, run the paddle two hours and let the hides lie in the liquor an hour or two longer, then take them out and let them press and drain before splitting or tanning them. If pickling is done in a drum, use twelve gallons of water, ten pounds of salt and one and a half pounds of sulphuric acid for one hundred pounds of hides. Run split hides

in the pickle one-half or three-quarters of an hour, and whole hides and kips one and one-half hours; then horse them up to drain.

Split hides are now in condition to be tanned in any chrome, vegetable, or combination process without further treatment. Whole hides can either be tanned, or split in pickled condition and then tanned. Splitting out of acid pickle does not produce as firm leather as splitting out of alumina and salt pickle or splitting after tanning. When hides are not split out of lime it is advisable to either pickle them with alumina and salt, and then to split them, or else to tan them whole and to split them after they are tanned.

METHODS OF SPLITTING.

Splitting out of Lime.—Hides to make good chrome leather should come from the unhairing machine firm and hard. If they are soft and flabby, they will make very poor leather, as there is nothing in the process of making chrome leather that will fill the hides and make up for the lost substance. After the hair is removed, the sides should be washed in lukewarm water for fifteen minutes and then worked by hand over the beam for short hair. This work is very important, as it is imperative that all fine hair be gotten rid of. And even if there are no fine hairs, working out the grain opens up the cells of the hides and makes the grain fine and clear. After this work has been done the sides are put into cold water over night to harden for splitting. The next morning they are ready to be split. In splitting the sides, a six-ounce grain from the machine will finish up four and a half ounces of leather as it loses an ounce and a half going through the various processes.

All tag ends and pieces of flesh should be trimmed from the sides before splitting is begun, so that there will be nothing to interfere with the hide feeding into the splitting machine freely. After the sides are split they should be run in a wash-wheel for fifteen minutes with cold water to open them up and remove the glaze caused by the belt knife. The next process is bating.

Splitting out of Sulphate of Alumina and Salt Pickle.—If it is desired to split the hides out of a pickle, they should be fine-haired, washed and bated and then pickled. The pickling with sulphate of alumina and salt is done in this manner: For every hundred pounds of sides dissolve four pounds of sulphate of alumina and ten pounds of common salt in six gallons of boiling water, then add six gallons of cold water and use the liquor after it has cooled to 70 degrees Fahr. Put the liquor into the drum, then put the sides in. Drum the sides in the pickle one hour, then horse them up smoothly and let them press and drain until the next day. Hides pickled this way should not be previously pickled with acid and salt. If the splitting machine has a corrugated roll, the sides can be split right off the horse. If the machine has a smooth roll, the sides should be hung up to sammy, or pressed or put out on a putting-out machine to get them into condition for splitting. The grains should be split at the same thickness that the finished leather is to be as they do not fall away like grains split from limed hides. Hides pickled with alumina and salt split just as easily as bark-tanned leather, and the splits are just as good as those taken from the limed hides. After the sides are split, the grains can be shaved while in the pickled condition and this saves putting them out for shaving after they are tanned. The grains are then ready to be tanned.

Splitting after Tanning.—To tan the sides in a chrome process and then to split them is the practice of some tanners. The sides are tanned in a one-bath chrome process in a paddle-vat or by suspension; and when they are well struck through with the tan, they are pressed and split. The pressing removes the surplus water and makes the leather drier and firmer. After pressing, the sides should be run in a dry mill until they are opened up and ready to split; they should then be jacked the same as bark leather and split to the thickness that the finished leather is to be. After they are split, the grains are shaved and retanned.

Splitting out of Acid Pickle.—When hides are split in acid-

pickled condition, they are allowed to drain twenty-four hours after being pickled, and are then pressed to remove surplus liquor and milled to remove the press marks; they are then split to the required thickness. Pickled grains finish about the weight they are when split. After splitting, the grains can be shaved or they can be shaved after they are tanned.

PROCESSES OF CHROME TANNING FOR SIDE LEATHER.

Process for Acid-Pickled Grains.—When hides are split out of lime, the grains are then bated, washed and pickled. The processes of tanning such grains are the same as for grains split from acid-pickled sides. The two-bath process is practiced as follows: The pickled grains are weighed. For one hundred pounds of them six pounds of bichromate of potash and one and a half pounds of muriatic acid and twelve gallons of water constitute the first bath. The potash is dissolved in three gallons of boiling water; then cold water is added to make twelve gallons of liquor, and to this the muriatic acid is added. The grains are put into a drum and processed in the solution for three hours or until the yellow color has penetrated through the thickest grain. The grains are then taken out of the drum, placed over horses and allowed to drain and season for twenty-four hours. The second bath is prepared in the meantime. Twenty pounds of hyposulphite of soda are dissolved in four gallons of boiling water; cold water is then added to make fifteen gallons of liquor. Three pounds of muriatic acid are stirred into two gallons of cold water. The sides are put into the drum with part of the solution of hyposulphite of soda, and the drum is set in motion. The muriatic acid solution and the rest of the hyposulphite liquor, mixed, are then poured into the drum through the funnel attached to the hollow gudgeon. The drum is run three or four hours, at the end of which time the grains are a blue color through and through and are tanned. The whole of the hyposulphite of soda solution can be put into the drum and after the drum is started the acid should be added at once. When they are

tanned, the sides should be placed over horses for twenty four hours before they are washed and finished.

Good leather can also be made by using five pounds of bichromate of potash and one pound of sulphuric acid for one hundred pounds of grains as the first bath, and sixteen pounds of hyposulphite of soda and one and a half pounds of sulphuric acid for the second bath, the tanning being done in the manner that has been described.

One-Bath Processes for Acid-Pickled Grains.—1. The one-bath process of chrome tanning is much safer and more economical than the two-bath. One way to use the process is as follows: For every hundred pounds of grains, a solution is prepared consisting of two pounds of Glauber's salt, five pounds of common salt and fifteen gallons of water at 90 degrees Fahr. The grains are drummed in this solution forty-five minutes; then the drum is stopped, the grains are thrown back upon the pins and the liquor is drained out of the drum. Five pounds of salt and twelve gallons of lukewarm water are then put into the drum and the grains are drummed in the salt water ten minutes. In the meantime fourteen pounds of concentrated chrome liquor are dissolved in six gallons of hot water. One-third of this is poured into the drum and the drumming is continued one half-hour. Then another third is added and the drum is run one hour; and then the rest of the chrome liquor is added and the grains are drummed until they are tanned, which takes five or six hours. The leather is then taken from the drum, allowed to drain for twenty-four hours; then pressed and shaved if necessary, and then washed, colored and fat-liquored. It is always advisable to let the leather remain in the liquor over night after it is tanned, enough water being added to the liquor to cover the leather well.

2. In this process a liquor made of sulphate of alumina and sal soda is used. For every hundred pounds of pickled sides four pounds of sulphate of alumina are dissolved by boiling in five gallons of water, and in another vessel four pounds of sal soda are dissolved by boiling in five gallons of water. The

soda solution is then poured very slowly, and with constant stirring into the alumina solution, and the mixture is allowed to get cold before it is used. The sides are put into the drum with ten pounds of salt and eight gallons of water and are drummed ten minutes. The alumina-soda liquor is then poured into the drum and the drumming is continued for one hour. The liquor is then drained off, a few pounds of salt and ten gallons of water are put in with the sides, and the chrome tanning is then proceeded with in the manner described in the preceding paragraph.

Process for Alumina-Pickled Grains.—The grains are put into the drum with ten pounds of salt and fifteen gallons of water for every hundred pounds of them and are run in the brine twenty minutes. Twelve pounds of concentrated one-bath liquor are dissolved in six gallons of warm water and poured into the drum in portions of one-fourth at a time at intervals of thirty minutes, and the grains are drummed until they are tanned through, which usually requires five or six hours. The leather is then left in the liquor over night, run an hour the next morning, then drained twenty-four hours, washed and colored.

Processes for Unsplit Sides.—1. Sides that are not split until after they are tanned are tanned most satisfactorily in one-bath chrome liquor in a vat with paddles. They are bated, washed and pickled either with sulphuric acid and salt, or with sulphate of alumina and salt. For the tanning process a vat with paddles may be used. For every hundred gallons of water in the vat thirty-five pounds of salt are put in and dissolved. The hides are then put in and the paddles are run for half an hour. Concentrated chrome tanning material is then dissolved with warm water until the solution stands 50 degrees Baumé scale. When the hides have been in the salt water thirty minutes two quarts of the chrome liquor are added and the paddle is run an hour. Three quarts of chrome liquor are then added and the paddles run three hours. More chrome-material is then added and the hides are kept in the bath until they are tanned through.

The tan bath can also be made by adding three gallons of concentrated chrome liquor to the salt water to start with and then adding three or four gallons more for every hundred gallons of water as the tanning proceeds.

When the hides are tanned, which is ascertained by the tanner cutting into one or more and noting the blue color clear through, and the dry, white fibers when scraped with a knife, they are taken out and pressed for splitting, milled in a dry-mill to open them up, jacked the same as bark-leather, and then split to the desired substance. The grains and splits are then put into a drum and retanned. For every hundred pounds of leather, five pounds of salt and ten gallons of water are put into the drum, and the leather is run in it for ten minutes. Two quarts of the prepared chrome liquor are put into the drum and the leather is drummed in the liquor an hour; then two more quarts of liquor are run into the drum and the leather is run for two hours, then drained for twenty-four hours, washed and colored.

Retanning can also be done by putting the leather into chrome liquor in a vat; but the drum-method is the most expeditious.

If the hides are tanned in a drum they need to be drummed more than twice as long as hides that were split out of lime or pickle. The processes of tanning pickled grains that have been described can be used in tanning unsplit hides, but they must be given more time.

2. Whole sides can be tanned with the two-bath chrome process by being drummed for six or seven hours in the first bath and seven or eight hours in the second bath. Hides tanned in a one-bath process are more easily retanned than those tanned in a two-bath process. The latter may be retanned with gambier or palmetto with benefit to color, appearance of the grain and feel.

Washing and Shaving.—After the leather is tanned or retanned, as the case may be, it should be allowed to press and drain twenty-four hours, and then washed. The first washing

is done in a closed drum with one pound of borax dissolved in fifteen gallons of warm water for one hundred pounds of leather. The leather should be washed for half an hour, then put into a wash-mill with running water and washed for an hour. All trace of acid and tanning salts should be washed out; the leather then struck out or pressed to remove the surplus water, and then shaved if it was not shaved before it was tanned. The next process is coloring.

PRACTICAL METHODS OF COLORING CHROME UPPER LEATHER.

Dyeing with Natural Dyestuffs. Receipt No. 1—Light Tan.—After chrome-tanned sides have been washed and shaved, they should be sorted, and those that are suitable for colors selected and weighed. A light shade of tan can be obtained on one hundred pounds of leather by using

Yellow Fustic Extract. 2 pounds.

Put the leather into the drum with twelve gallons of water at a temperature of 140 degrees Fahr. Start the drum, then pour into it through the hollow axle the fustic liquor made by dissolving the extract in three gallons of boiling water. Run the leather in the dye one-half hour; then add

Titanium Potassium Oxalate 4 ounces.

Dissolve this in a gallon of hot water and pour it into the drum. Drum the leather fifteen minutes longer, then wash and fat-liquor it.

Receipt No. 2—Dark Tan.—For one hundred pounds of shaved leather use

Red Fustic Extract. 4 pounds.

Put the leather into the drum with twelve gallons of water at 140 degrees, and after the drum is started pour the fustic liquor in and run the drum one-half hour. Then add

Titanium Potassium Oxalate 6 ounces,

dissolved in hot water, to the contents of the drum, and run the drum fifteen minutes longer. A nice shade of dark tan results. Then wash and fat-liquor the leather.

Receipt No. 3—Oxblood.—This popular shade is obtained by using natural dyestuffs in the following manner: For one hundred pounds of leather use

Hypernic Extract.....	2¼ pounds.
Logwood Crystals.....	1½ ounces.
Leather Red	½ ounce.

Dissolve these materials in four gallons of boiling water. Put the leather into the drum with ten gallons of water at 140 degrees. Start the drum and pour the dye-liquor through the hollow axle. After the leather has been running in the liquor one-half hour, dissolve and add

Titanium Potassium Oxalate	4½ ounces
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and continue drumming for fifteen minutes. Then wash and fat-liquor the leather.

Receipt No. 4—Chocolate Brown.—For one hundred pounds of leather use

Yellow Fustic Extract	2¼ pounds.
Hypernic Extract	10 ounces.
Logwood Crystals.....	3 ounces.

Boil until dissolved. Put the leather into the drum with water at 140 degrees Fahr. and run the drum one-half hour after the dye-liquor has been put in. Then dissolve and add

Titanium Potassium Oxalate	5 ounces.
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and drum the leather in the combined liquors fifteen minutes longer; then wash and fat-liquor it.

Receipt No. 5—Alizarine Red-Brown.—A popular shade of red-brown is obtained by applying the following alizarine dyes in the quantities stated for one hundred pounds of leather:

Alizarine Brown G	4 ounces.
Alizarine Yellow R extra.....	4 ounces.
Alizarine New Yellow extra.....	¾ ounce.

Dissolve the alizarine brown G by boiling in eight gallons of water, then add four gallons of cold water and use the solution at 170 degrees Fahr. Drum the leather in this solution fifteen minutes. In the meantime dissolve the other dyes in three gallons of boiling water and pour the solution into the drum. Run the drum fifteen minutes, then drain the liquor out and

fat-liquor the leather. It is also beneficial to the color to add one pound of extract of fustic dissolved in hot water to the contents of the drum after the second fifteen minutes and run the drum another quarter hour; then dissolve and add to the contents of the drum two ounces of bichromate of potash. Run the drum ten minutes, then drain the liquor out and wash the leather in three changes of warm water and then fat-liquor it.

Receipt No. 6—Alizarine Brown.—For each hundred pounds of leather dissolve in six gallons of boiling water

Alizarine Leather Brown B, No. 9052 12 ounces.

When the dye is dissolved add cold water to make ten gallons and use at 170 degrees Fahr. Put the leather into the drum and after the latter is started pour the dye through the axle and drum the leather one-half hour. In the meantime dissolve in a gallon of warm water

Yellow Fustic Extract 1 quart.

Add this solution to the contents of the drum and run it for fifteen minutes. Then drain off the liquor, wash and fat-liquor the leather.

Receipt No. 7—Mordant for Aniline Colors.—For one hundred pounds of leather use

Gambier 2 pounds.

Extract of Fustic 1 pound.

Boil in four gallons of water until dissolved; then cool down with cold water to make twelve gallons. Use at 130 degrees Fahr. and drum the leather in it one-half hour. Then dissolve in a pail of hot water and pour into the drum

Titanium Potassium Oxalate 4 ounces.

Drum the leather fifteen minutes. Then if acid dye is to be applied run off the spent mordant and run in the dye; then wash and fat-liquor the leather.

If basic dye is to be applied after running in the mordant, if the mordant is all taken up, run the liquor off and apply the color. If the mordant bath is not exhausted it is advisable to wash the leather before running in the dye. Any shade of tan

or brown can be readily obtained on leather treated in the manner described.

Receipt No. 8—Palmetto Mordant.—For any shade of aniline coloring palmetto extract serves satisfactorily as a mordant. Use from two to three pounds dissolved in four gallons of boiling water and then increased to twelve gallons by the addition of cold water. Add a little glycerine to the liquor. Apply the liquor to the leather at 130 degrees Fahr. Drum the leather in the liquor one-half hour; then add four ounces of titanium salts dissolved in hot water and after running fifteen minutes longer, drain the liquor out of the drum and run the leather in the aniline dye. This process produces full, even and permanent shades.

Receipt No. 9—Peachwood-Fustic Mordant.—This is a splendid process for coloring chrome side leather the oxblood shade. Boil together in a few gallons of water

Extract of Fustic	1 pound.
Extract of Peachwood	2 pounds.

Add enough cold water to make six gallons of liquor and use at 125 degrees Fahr. For one hundred and twenty feet of leather, more or less: Put the leather into the drum with ten gallons of water at 110 degrees and start the drum; then pour in the fustic-peachwood liquor and run the leather in it one-half hour. While the leather is drumming, dissolve

Amaranth 3/R.....	12 ounces.
Glycerine	8 ounces.

in two gallons of boiling water; strain and add two gallons more of water. Add this liquor to the contents of the drum and run the drum one-half hour. Then stop the drum, take the leather out and rinse it in clean water. Empty the drum; put the leather back and run it in a solution of two ounces of bichromate of potash for fifteen minutes. The leather is then ready for fat-liquoring. The color can be deepened by using a stronger fustic-peachwood liquor. For a light shade of oxblood use more fustic extract and less peachwood. Sumac extract may be used for the mordant. One dozen sides may be

given from one and a quarter to one and a half pounds of the extract, according to their size.

Receipt No. 10—Gambier Mordant.—Three pounds of gambier for one hundred pounds of leather prepare the leather for aniline coloring. Boil the gambier in four gallons of water; then add cold water to make twelve gallons of liquor. Use at 120 degrees Fahr. and run the leather in it one-half hour. Then dissolve four ounces of titanium salts in hot water, add it to the contents of the drum and run the drum ten minutes. Drain the liquor out and apply the aniline solution for the shade desired. Quermos extract may be used with equally good results, the same quantity as of gambier being used.

Receipt No. 11—Fustic Mordant.—Fustic extract is an excellent mordant for tan shades. Use from two to three pounds for one hundred pounds of leather. Dissolve in boiling water, then increase to twelve gallons by adding cold water, use at 120 degrees Fahr. Drum the leather in it one-half hour. Dissolve and add four ounces of titanium salts and run the drum fifteen minutes longer. Then drain the liquor off and color with aniline dye.

The Use of Tartar Emetic.—Chrome-tanned sides, previous to the application of aniline dye, must be prepared with some tanning or coloring extract in the manner that has been described. There frequently results imperfect and spotted coloring due to uncombined tannin on the grain of the leather. To overcome this and to fix the color upon the leather, many dyers use tartar emetic. The leather is run in the sumac, gambier, fustic or palmetto bath, as the case may be, the required length of time. Tartar emetic dissolved in hot water is then added to the bath and the drum is run fifteen minutes longer. The leather is then rinsed off in warm water, the spent liquor run into the sewer, the dye liquor is prepared and the leather is run in it one-half hour, then washed and fat-liquored. When tartar emetic is used, no titanium salts or bichromate of potash is necessary as it serves to clear the grain and to combine with the mordant to fix the dye upon the leather.

Since chrome leather is invariably colored before it is fat-liquored and dried, and since the drying and finishing of the leather frequently change the shade, it is very important that the dyer uses the quantity of dye that will color the leather the shade that is wanted when it is finished. The quantity of dye-stuff required to color a lot of leather depends, of course, upon the size of the skins or sides, and must be decided by the dyer. Before proceeding to carry on coloring operations on a large scale it is advisable to try a few experiments on a small scale, and in this way ascertain the exact quantity of dye to use.

Dissolving Aniline Dyes.—Care should always be taken to have aniline dye completely dissolved before using it. A good way to dissolve aniline dye is to put it into a clean pail and to pour over it a gallon or two of boiling water; keep stirring while this is being done. Then hold the pail under a copper steam-pipe and boil the dye thoroughly for ten minutes. Have another pail ready, over the top of which is spread a piece of cheesecloth. Pour the color solution through this into the pail, thus straining it. Then cool down with cold water and use at a temperature of 120 degrees Fahr. It is of great importance that the drum and skins be kept in motion while the dye solution is being put into the drum. The dye should be added a portion at a time until all is in the drum, then the leather should be drummed at least fifteen minutes before the drum is stopped.

Titanium Mordants.—The double titanium salt, Titanium Potassium Oxalate, is valuable material for the leather dyer. Applied to chrome leather treated with gambier, fustic, sumac, palmetto or other tannin, it unites with the tannin to form a yellowish-brown base, which is a most suitable foundation color for all shades of yellow, tan, brown, oxblood, etc. Leather so treated takes basic or acid aniline readily; and the color that results is full and uniform and permanent. The shade of yellow-brown produced varies with the kind of tannin in the leather, young fustic producing a light tan, gambier and fustic a brownish tan, and sumac a yellow shade. The leather is

drummed in the sumac, gambier or fustic bath a few moments, then the solution of titanium salt is added to the bath and the drumming is continued for ten or fifteen minutes.

If the mordant is all taken up at the expiration of the time stated, the liquor is drained out and either basic or acid aniline solution run in and the leather drummed in it, then washed and fat-liquored. If the mordant bath is not exhausted, the leather should be washed before basic aniline is applied. Washing is not necessary for acid dyes, and only necessary when the mordant bath is not exhausted, which is seldom the case.

The dealers in aniline colors can match any shade and furnish formulas. The formulas given in this book have been used in practice by practical dyers with perfectly satisfactory results.

DYEING CHROME SIDE LEATHER BLACK.

Four practical processes of dyeing chrome side leather black are described here. Any one of them can be used with satisfactory results.

Receipt No. 1—Logwood and Bichromate of Potash.—For dyeing one hundred pounds of leather, washed and shaved, ready for coloring, use

Logwood Crystals.....	1½ pounds.
Extract of Fustic	4 ounces.
Borax.....	3 ounces.

Boil the logwood and borax until dissolved in six gallons of water. Then dissolve the fustic paste in two gallons of hot water and stir it into the logwood liquor. Then add enough cold water to make twelve gallons of dye. In a pail dissolve

Bichromate of Potash....	1¼ ounces.
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Put the leather into the drum with three or four gallons of water and run the drum five minutes to wet the leather. Then pour the prepared logwood liquor at 120 degrees Fahr. into the drum and run the leather in it twenty minutes. Next pour the bichromate of potash solution into the drum and continue the drumming for ten minutes, when the process should be com-

plete. Wash the leather in three changes of water; then fat-liquor it.

Receipt No. 2—Logwood and Titanium Salts.—Prepare a logwood solution by boiling logwood and borax, then add fustic paste and have twelve gallons of the dye as described in Receipt No. 1. In a little hot water in a pail dissolve for one hundred pounds of leather

Titanium Potassium Oxalate 6 ounces.

Run the leather in the logwood liquor twenty minutes. Then add the titanium solution to the liquor and run the drum fifteen minutes. A good black results. The leather should then be washed, fat-liquored and finished.

To get the black deeper into the leather or through it, drum it in palmetto extract, then in a solution of three ounces of titanium salts in solution; add the logwood, and after twenty minutes pour in three more ounces of titanium salts in solution, and after running the drum ten minutes longer wash and fat-liquor the leather.

Receipt No. 3—Logwood and Copperas.—Drum the leather in the logwood-fustic liquor twenty minutes; then pour into the drum, in solution,

Copperas 2 ounces.

Bluestone $\frac{1}{2}$ ounce.

These articles should be dissolved in three gallons of hot water. Run the drum fifteen minutes; then wash the leather in three changes of warm water to remove all the dye and then proceed to finish it.

Receipt No. 4—Logwood and Nigrosine.—This process colors the flesh blue and the grain black. For each dozen sides dissolve eight ounces of Nigrosine P in hot water, and drum the leather in the solution twenty minutes or until the color is well taken up. Then drain off all the water and fat-liquor the leather with a suitable fat-liquor; after which black the grain on a table by brushing in logwood and copperas or logwood and bichromate of potash, first applying the logwood and then the copperas or other striker. When the grain has become

black, wash it, set it out, apply a coat of oil, and hang the leather up to dry.

When leather is drummed in a logwood liquor containing borax until the color is taken and then spread on a table or run through a machine and blacked upon the grain, it dries out with blue flesh and black grain.

After leather is dyed with logwood and striker, it should be very thoroughly washed before it is dried and finished to get rid of all the dye liquor.

It is considered by some tanners conducive to a better color to run the leather in a solution of palmetto extract or of gambier before giving it the dye. A good method is to apply palmetto liquor, say two pounds to one hundred pounds of leather, then to drum the leather in an alkaline logwood-fustic liquor, and then to develop the color with a solution of titanium salts as described in Receipt No. 2.

Good results are also secured by fat-liquoring the leather first, then running it in gambier or palmetto, and afterward dyeing with logwood and striker. A better black as to color and durability is obtained by using titanium salts in place of iron liquor.

FAT-LIQUORS FOR CHROME SIDE LEATHER.

After the leather has been colored, it should be washed and either struck out or pressed. It is then ready to be fat-liquored. A suitable drum should be heated with live steam, all condensed steam drained out, the leather put into the drum and drummed in it ten minutes to warm it and make it more receptive to the fat-liquor. The fat-liquor, previously prepared, is now poured into the drum through the funnel attached to the hollow axle. After the fat-liquor is in the drum, the leather should be drummed in it for forty minutes to absorb the oil and grease and leave the water behind. The temperature of the fat-liquor may range between 120 and 150 degrees Fahr. At the expiration of the forty minutes, the leather should be taken out of the drum and placed over a horse to

drain twenty-four hours before being struck out, oiled on the grain and hung up to dry. This is the most approved method of applying fat-liquor to leather. Any one of the following receipts may be used with the assurance that the leather will be fat-liquored in a satisfactory manner.

Receipt No. 1.—For colored or black leather that is to be glazed, use for each hundred pounds of it

Fig or Olive Soap.....	1 pound.
Neatsfoot, Cod or Olive Oil	2 pounds.
Moellon Degras	2 pounds.
Caustic Soda	1 ounce.

Boil the soap in six gallons of water; add the oil and boil ten minutes; turn off the steam and add the degreas, stirring for five minutes. Dissolve the soda in a little water and stir it into the fat-liquor, which, after six gallons of cold water have been added, is ready for use.

Receipt No. 2.—To make fifty gallons of excellent fat-liquor for chrome side-leather use

Palermo Fig Soap.....	20 pounds.
Wyandotte Tanner's Soda.....	5 pounds.
French Moellon Degras.....	100 pounds.

Boil the soap in twenty-five gallons of water for fifteen minutes. Shut off the steam and add enough water to bring the temperature down to 140 degrees Fahr. Then add the soda and degreas and stir for five minutes. Do not boil the liquor after adding the soda and degreas, but, after stirring thoroughly, fill the barrel up to fifty gallons. Two gallons of this fat-liquor thinned with six gallons of hot water fat-liquors one hundred pounds of leather. The drum should be warm and the fat-liquor should be at 130 degrees Fahr. when it is given to the leather. After the leather has been drummed in the fat-liquor forty minutes, take it out, rinse it in a tank of warm water and place it over horses to drain.

If the leather is greasy after fat-liquoring, wash it in a drum in a solution of a few pounds of Wyandotte soda dissolved in a half-barrel of warm water. This fat-liquor is good for any kind of chrome upper leather; but it must be made according to the directions or the leather will come out of the drum greasy.

Receipt No. 3.—For heavy English or storm grain leather, this is a good fat-liquor:

Soap	1½ pounds.
Tallow	4 pounds.
German Degras.....	4 pounds.
Sod Oil.....	4 pounds.

Boil the soap until dissolved, then add the other ingredients and boil one-half hour. There should be twelve gallons of fat-liquor. Use at 130 degrees Fahr., in the usual manner.

Receipt No. 4.—A good fat-liquor for one hundred pounds of colored leather is made of

Good Fat-liquor Soap	½ pound.
Olive Oil	2 pounds.
Treated Cod Oil.....	2 pounds.
Birch Oil.....	2 ounces.
Salts of Tartar	3 ounces.

Boil the soap in water until it is dissolved, then add the olive and cod oil and boil for twenty minutes; then add the birch oil and the salts of tartar dissolved in a little hot water. Add water to make twelve gallons of fat-liquor and use at a temperature of 140 degrees Fahr.

Receipt No. 5.—For grained chrome leather, either black or colored, one hundred pounds, use

Soap ..	½ pound.
Olive Oil	2 pounds.
Moellon Degras	7 pounds.
Strong Ammonia	½ pint.

Prepare the fat-liquor by boiling soap and oil, then add water to make twelve gallons and just before using add the ammonia.

Receipt No. 6.—For one hundred pounds of colored or black grain make a fat-liquor of

Castile Soap	½ pound.
Olive Oil	2 pounds.
Moellon Degras	2 pounds.
Salts of Tartar	2 ounces.

Boil the oil, soap and degas one-half hour in six gallons of water, then add the salts of tartar and stir well. Have ten gallons of fat-liquor. After fat-liquoring, dip the sides one at

a time into warm water and then let them drain until the next day before striking them out and hanging them up to dry.

Receipt No. 7.—This is a good fat-liquor for one hundred pounds of dull finished leather.

Fig or Olive Soap.....	1 pound.
Neatsfoot Oil	4 pounds.
Degras	2 pounds.
Caustic Soda	1 ounce.

Prepare this in the usual manner, adding the alkali last. There should be ten gallons of fat-liquor, and it should be used at a temperature of 125 degrees Fahr.

Receipt No. 8.—This is a good fat liquor for leather colored with basic aniline dye. Dissolve four ounces of salts of tartar in three gallons of hot water, then stir in three pounds of French moellon degreas and stir well. Add water to make twelve gallons and use it at a temperature of 140 degrees Fahr. This quantity is for one hundred pounds of leather.

Receipt No. 9.—Put ten pounds of Palermo Fig or other good soap into a clean barrel with ten gallons of water. Boil with steam until dissolved. Then take four gallons of neatsfoot oil and cut it by stirring into it a few ounces of borax dissolved in hot water. Add the oil to the soap and boil again; then add six pounds of moellon degreas and boil until the liquor is thoroughly emulsified. Run in enough water to make forty gallons of fat liquor. Four gallons of this emulsion may be used for each dozen sides.

Receipt No. 10.—For one hundred pounds of heavy grain chrome leather:

Fig Soap.....	1 pound.
German Degras.....	3 pounds.
Neatsfoot Oil.....	3 pounds.
Sod Oil.	3 pounds.
Borax	4 ounces.

Boil the first three ingredients in six gallons of water for one-half hour. Then add the sod oil and borax and stir thoroughly. Add water to make twelve gallons of liquor, which may be applied to the leather at any temperature between 125 and 140

degrees Fahr. If the leather is greasy wash it in a warm solution of Wyandotte soda. If the fat-liquor is not fully taken up by the leather, pour into the drum four ounces of salts of tartar dissolved in three gallons of hot water and run the drum fifteen minutes longer. The grain should receive a good coat of cod or neatsfoot oil before the leather is dried.

Receipt No. 11.—For soft leather, colored or black, this fat-liquor is recommended:

Fig Soap	1 pound.
Neatsfoot Oil.....	3 pounds.
Moellon Degras	3 pounds.
Salts of Tartar.....	4 ounces.

Boil the soap and oil in four gallons of water; then add the moellon degreas and salts of tartar and stir five minutes. Add water to make twelve gallons of fat-liquor and apply to the leather at 135 degrees Fahr. Dip each piece of leather in a tub of clean, hot water after fat-liquoring, then drain it until the next day.

Receipt No. 12.—Acid fat-liquor or sulphated oil is splendid fat-liquor material for chrome side leather. One hundred pounds of leather may be given five pounds of the oil diluted in twelve gallons of hot water. The drum should be warm, and the leather should be warmed also before it is given the fat-liquor. After the leather has been drummed in the fat-liquor forty minutes it should be rinsed off in clean, hot water, drained, struck out, given a coat of one part glycerine and three parts water, but no oil, and hung up, dried and finished.

Receipt No. 13.—Dissolve four pounds of soda ash in the smallest amount of water that will dissolve it. Stir the solution into ten gallons of water in a barrel and then turn on steam and bring the water to a boil. Mix into the boiling water twelve gallons of moellon degreas and boil continuously for six hours; then add enough water to the fat-liquor to make forty-eight gallons.

For smooth glazed, boarded and dull finished leather, either black or colored, use from two to two and a half gallons for

each hundred pounds of leather. For boarded leather the smaller quantity and for soft mat stock the larger quantity should be used. A soap liquor, made by boiling chip or fig soap, may be used with the degreas liquors. Any amount of soap can be used. The fat-liquor should be stirred before and after the soap is added and enough water should be used to make ten gallons of fat-liquor for one hundred pounds of leather. When the degreas liquor is used alone and no soap is added to it give the leather from three to five per cent., thinned down with water and used at 110 degrees Fahr. A good way to combine degreas and soap is to make a soap solution by boiling one pound of soap to a gallon of water, making as many gallons as may be required in this way. Add to the necessary quantity of soap liquor from two to three quarts of moellon degreas for one hundred pounds of leather; use at 110 degrees and drum the leather in it forty minutes. For boarded, glazed and dull leather the mixture of oil and degreas is most satisfactory; but for enameled leather degreas fat-liquor should be used alone.

FINISHING CHROME SIDE LEATHER.

After the leather has been fat-liquored, it should be placed over horses to press and drain until the next day, when it should be thoroughly struck out and oiled on the grain side. For glazed leather use one part neatsfoot and three parts paraffine oil, or equal parts of good olive and paraffine oils or treated cod oil, giving the leather a light coat and then hanging it up to dry. Dull finished leather may be oiled with treated neatsfoot or cod oil, with dull Morocco dressing oil or with equal parts of neatsfoot and paraffine oils. The oil should be applied evenly over each piece of leather and it is best to warm it before using it. No oil should be put onto the flanks. After the leather has been oiled it should be hung up to dry. The temperature of the room should be about 80 degrees, and there should be a good circulation of air so that the leather will not dry too rapidly or have a parched appearance. When dry, the leather is dampened and staked. The best way to dampen

is to put about a dozen pieces of leather into hot water, leave them therein a few minutes, then pack them in a clean dry box and cover the pile with a thick layer of damp sawdust. The next day the leather should be in condition to be staked. After staking it is tacked out smoothly and allowed to dry. When it is dry, it is trimmed and seasoned for finishing.

Dull Finish.—Give the leather a coat of finish; hang it up to dry; then give another coat; dry and iron with a hot iron; then stake it lightly. Leather properly tanned and fat-liquored, after finishing in this manner, is soft and full and with a fine, tough grain.

Glazed Finish.—Stake the leather after trimming; then give it a coat of finish and dry it. The next operation is glazing. Then give the leather another coat of finish, dry and stake it; then glaze again. If the finish is satisfactory, oil with hot oil, using a good finishing oil or equal parts of neatsfoot and paraffine oil. This oil protects and preserves the finish. Only a light coat is necessary. The leather may require a third coat of finish and a third glazing to make it satisfactory.

Boarded Finish.—Treat the leather the same as for smooth glazed. After the second glazing board it from head to tail, then across from side to side, oil it and it is done. Dull English grain leather is given a good coat of seasoning, dried, rolled on a heavy jack with heavy pressure, then grained and oiled heavily with a mixture of neatsfoot and paraffine oils. To obtain a sharp and regular box grain, it is well to press the leather before boarding. A powerful press and sharp-cut rolls are necessary. After this has been done, the leather is boarded.

Clearing the Grain.—Thorough cleansing of the grain is of importance in getting a clear and uniform gloss. Lactic acid diluted with water is rubbed into the grain and dried. The grain is then rubbed with a clean rag, given a coat of finish, dried and glazed. Frequently it is necessary to repeat the operation, giving two coats of the acid. Barberry juice also may be used for the purpose.

FINISHES FOR CHROME SIDE LEATHER.

For Glazed and Bright Boarded Finish.

Logwood Crystals	2 ounces.
Whole Flaxseed	2 ounces.
Nigrosine Black	2 ounces.
Bichromate of Potash	$\frac{1}{2}$ ounce.
Vinette	$\frac{1}{2}$ pint.
Blood	1 quart.
Glycerine	$\frac{1}{2}$ pint.
Crystal Carbolic Acid	1 ounce.

Boil the flaxseed one-half hour in one gallon of water, then strain and add the logwood, nigrosine and bichromate of potash. Then cool down to 90 degrees F. and add the rest of the ingredients. If there is less than two gallons of finish add cold water to bring the quantity up to two gallons.

A bright glazed finish can also be secured by using the following finish.

Ivory Soap	1 pound.
Glue (frozen)	1 pound.
Logwood Crystals	8 ounces.
Nigrosine Black	8 ounces.
Bichromate of Potash ..	1 ounce.
Blood	8 quarts.
Carbolic Acid	4 ounces.

Boil the soap in eight gallons of water, and dissolve the glue in eight gallons of water. When dissolved add the soap solution to the glue solution. Then dissolve the logwood, nigrosine and bichromate of potash in eight gallons of water by boiling. When dissolved, cool down to 100 degrees F., and add the blood. Stir well and put in the carbolic acid. Use one quart of the glue and soap solution with two gallons of the blood solution.

Dull Finish.—The seasoning for dull finish may be made of:

Ivory Soap	1 pound.
Neatsfoot Oil	1 pint.
Whole Flaxseed	$\frac{1}{2}$ pound.
Beeswax	3 ounces.
Nigrosine Black	3 ounces.
Powdered Aloes	1 ounce.
Wood Alcohol	$\frac{1}{2}$ pint.

Boil the soap, oil, flaxseed and beeswax one-half hour in two gallons of water. Cool and strain. Then dissolve the nigrosine in a quart of hot water and add; and the aloes in the alcohol and add also. Stir the finish thoroughly and it is ready to be used.

Gun-metal Finish.—To get this finish give the leather a coat of bright seasoning, dry and glaze, then stake it. Then apply one coat of the following finish, and when it is dry, iron the leather and oil it off with hot oil:

Gum Tragacanth.	1 ounce.
Yellow Dye	$\frac{1}{2}$ ounce.
Glaze Seasoning	1 gallon.

Soak the gum tragacanth in two quarts of water for twenty-four hours; then stir it into a solution. Dissolve the dye in a quart of water. Take one gallon of bright seasoning made according to the first formula and stir into it a quart of the gum solution and then add the yellow dye solution, a little at a time, stirring well until the color of the finish has changed from black to green-black. If too much yellow dye is used the leather will be too green, which is undesirable.

For Oil or Storm-grain Leather.—For chrome-tanned oil grain this formula makes good finish:

Gelatine.	$\frac{1}{2}$ pound.
Black Nigrosine	2 ounces.
Olive Oil	1 pint.
Ammonia.....	$\frac{1}{2}$ pint.

Dissolve the gelatine in two gallons of water, add the nigrosine, and heat until gelatine and nigrosine are dissolved. Let the mixture cool, and just before it begins to thicken add the oil and ammonia; stir thoroughly. After the leather has been seasoned and grained, oil the grain with a mixture of neatsfoot and finishing oil, applied hot.

Another finish for heavy grain leather is made of:

Olive-green Soap.....	$\frac{1}{2}$ pound.
Moellon Degras	1 quart.
Irish Moss ..	4 ounces.
Logwood Crystals	2 ounces.
Nigrosine	2 ounces.

Boil in a gallon of water for twenty minutes; cool and strain and add water to make two gallons of finish. Give the leather a liberal coat of the finish, and when half dry roll on a heavy jack, using heavy pressure; then grain the leather and oil off with hot oil. The leather should be rolled while it is damp, as this causes a smoother grain and a more uniform break when graining.

Finish for Colored Leather.—

Ivory or Castile Soap.	1½ pounds.
French Gelatine	3 ounces.
Blood Albumen	3 ounces.

Soak the soap in six quarts of water for twenty-four hours; then soak the gelatine in a quart of hot water. When cool, mix into the soap and stir until dissolved. Soak the albumen in two quarts of warm water over night, then stir it into the soap. Take a quart of the finish and strain it into six quarts of water, 90 degrees F.

CHROME SIDE GLOVE AND MITTEN LEATHER.

Hides for glove and mitten leather should be thoroughly limed and bated and made as soft as possible. Pickling and tanning are done in the various processes that have been described. After the leather is tanned, spread it evenly and smoothly over a horse to drain until the next day. If the sides were not split before tanning, they should now be split and made ready for coloring. If they were split before tanning, they are ready for coloring as soon as they have drained over night. Washing should not be done until after the leather is colored, fat-liquored and dried.

Coloring for Grain Finish.—The leather can be colored any shade that may be wanted by using wood, aniline or alizarine dyes. If yellow leather is wanted, the following process will be found satisfactory:

Boil twenty-five pounds of gambier in twenty gallons of water, then add one pint of muriate of tin and three ounces of tin crystals, stir thoroughly and then fill the barrel with water.

For fifty sides use four pails of this gambier liquor. Mix it with two gallons of water; and add to it one-half pound of picric acid and one-half pound of fustic dissolved in three gallons of hot water. Mix the color solution in a tub and use it at 90 degrees Fahr. Drum the leather in it one hour.

Another and perhaps better way is to mix four pails of the gambier liquor and two gallons of water and to drum fifty sides in the solution for one hour. Then add the picric acid and fustic dissolved in four gallons of hot water and run the drum thirty minutes longer. Take the leather out of the drum and let it drain until the next morning when it should be fat-liquored.

A light tan color that is suitable for this class of leather is obtained by dissolving two pounds of yellow fustic extract in six gallons of boiling water, then adding six or eight gallons of cold water, using the liquor at 130 degrees and drumming the leather in it for one-half hour. Then dissolve in a pail of hot water four ounces of titanium salts; add this solution to the contents of the drum and drum the leather for fifteen minutes; then wash and fat-liquor it. These quantities of material are sufficient for one hundred pounds of leather.

A darker tan is obtained by using four ounces of red fustic extract and six ounces of titanium salts in the manner described for light tan.

Yellow shade is also obtained by using fustic extract and Auramine II. For one hundred pounds of leather dissolve two pounds of fustic and one-third of a pound of tin crystals in six gallons of boiling water and increase to ten gallons of liquor by adding water. Drum the leather in this one-half hour. Then add to the liquor in the drum six ounces of Auramine II dissolved in two gallons of boiling water and run the drum twenty minutes, then drain the leather over night and fat-liquor it the next day.

Fat-liquor Receipt.—All of the fat-liquors described for chrome shoe leather are applicable to chrome glove leather. Or the following may be used:

Olive Chip Soap.....	12 pounds.
Glauber's Salt	3 pounds.
Borax	2 pounds.
Sod Oil	5 gallons.
Cod Oil	3 gallons.
Neatsfoot Oil	1 gallon.

Boil the first three ingredients for one-half hour; then add the oils and boil again for one-half hour; then fill up the barrel to make fifty gallons of fat-liquor. Use seven pounds of this fat-liquor for one hundred pounds of leather. Dilute it with hot water and use at 125 degrees Fahr., drumming the leather in it for forty minutes.

After the leather has been fat-liquored, it should be struck out, oiled, hung up and dried. When dry it should be very thoroughly washed with clean cold water in a wash-wheel for two hours or until it is thoroughly clean. Hang the leather up to dry, and when dry lay it in piles for ten days before finishing it.

Finishing.—Moisten the leather and stake it; then hang it up to dry. When dry, put it into the drum with three or four quarts of soapstone to fifty sides and run it for two hours, then stake it again and the leather is finished. Brushing the grain on a plush-wheel gives it a smooth finish that enhances the appearance of the leather.

CHROME BAG AND BELT LEATHER.

Black chrome leather with a printed or boarded grain is being used in the manufacture of hand and traveling bags and belts for personal use. The leather, when suitably fat-liquored and finished, is admirably adapted to these purposes, as it is strong, durable and waterproof. The main thing that must be guarded against is getting the leather too soft and greasy. It must be firm and dry, that is, greaseless. The sides are tanned in the same manner as for shoe leather, but are given less fat-liquor. It is desirable that the color penetrate through the flesh, so that the edges will show black and not blue. When the leather is greasy the grease strikes through the linings and

is easily perceptible. The leather must be fat-liquored just enough to make it supple without being soft and stretchy. The grain is boarded two ways or printed with a box grain and then boarded. Belts made of this material are almost indestructible, and bags give excellent satisfaction as regards appearance and wear. The more novel the leather can be made to appear the better it is liked, as there is unceasing call for new things in these lines of leather goods. Prices range from 16 to 20 cents per square foot.

WHITE SIDE LEATHER.

White leather is used in the manufacture of baseballs, belts, suspenders, etc. Bleached chrome leather is most suitable for such purposes, but there are also other processes of tanning that produce soft, tough white leather.

Tanning with Sulphate of Alumina. The hides are worked through the preparatory processes in the same manner as for chrome leather. If they are split out of lime, they should be bated, washed and pickled with sulphuric acid and salt. If they are bated and pickled whole, the sides should be split out of the acid pickle. Pickling is essential for this leather as it makes the sides whiter than they are when not pickled. Pickling can be done in a drum by using one pound of sulphuric acid, fifteen pounds of salt and fifteen gallons of water to each hundred pounds of sides. Drum the sides in this liquor one hour, then horse them up smoothly for twenty-four hours. To prepare the tan liquor boil in ten gallons of water twelve pounds of sulphate of alumina. In a pail dissolve in one gallon of water twenty-four ounces of bicarbonate of soda. Pour the soda solution very slowly and with constant stirring into the alumina solution. When mixed put the liquor to one side to cool down to 80 degrees Fahr.

Put the pickled sides into a drum with ten gallons of water, one pound of Glauber's salt and three pounds of common salt for one hundred pounds of sides. Drum the sides in the solution for twenty minutes, then drain off the liquor. Put into the

drum ten gallons of lukewarm water and four pounds of salt and drum the sides in the brine for ten minutes. Then pour into the drum half of the alumina and soda solution and drum the sides in it for three hours. At the end of the three hours take the sides out and place them over a horse until the next day, then hang them up to dry.

When the sides are dry put them back into the drum with eight gallons of water and drum them ten minutes; then add the other half of the alumina-soda liquor and run the drum three hours. Horse the leather up for twenty-four hours, then hang it up to dry.

Fat-liquoring with Acid Fat-liquor.—When the leather is dry let it lay in the crust in a clean dry room for ten days or two weeks; then dampen it with warm water preparatory to fat-liquoring. Acid fat-liquor or sulphated oil is the material to use as it imparts the necessary softness without discoloring the leather or making it greasy. The tanner can make his own acid fat-liquor or he can buy it ready for use. For each hundred pounds of dry leather use seven pounds of the oil and stir it into ten gallons of water at 95 degrees Fahr. until it is entirely dissolved. Put the moistened leather into the drum, start the drum and pour the oil solution through the gudgeon. Run the leather in the fat-liquor forty minutes: then let it drain over night. The next day strike out the grain and oil it with a mixture of French chalk, two parts of glycerine and four parts water. Apply this to the grain and then hang the leather up to dry.

Finishing.—Finishing consists simply of moistening the leather, staking it and tacking it on boards. When dry and taken from the boards, if not soft enough, restake it; or if staking does not soften the leather wet it and give it more fat-liquor. And if the leather does not seem to be entirely tanned, it can be put back into the drum and given more alumina and soda liquor, then dried as before. The appearance of the flesh can be improved by buffing it on an emery wheel.

WHITE CHROME LEATHER.

An excellent imitation of alum leather is made by tanning sides in a one-bath chrome process, and then either bleaching the leather with borax and sulphuric acid or treating it with flour or both. Hides for this process should either be split out of lime, bated and pickled or bated whole and pickled, and then split. Any one-bath process of chrome tanning can be used. When the leather is tanned, wash it in a fairly strong and hot solution of borax for one-half hour. Then prepare a solution of sulphuric acid and water, made by adding acid to water until the solution is as sour as a lemon. Take the leather from the borax bath and wash it in the acid bath; or drain the former out of the drum and put the latter in and wash the leather twenty minutes; then wash it in clear water to remove the acid, after which it is ready for fat-liquoring.

Treatment with Flour.—Drumming the leather in flour is another way to make it white. If the borax and acid treatment does not make the leather as white as is desired, the sides can be drummed in flour and water. The flour treatment can also be used alone, and the leather will be white enough for most purposes.

The leather is washed after tanning, and is then given the flour treatment. About fifty pounds of flour are used for from fifty to one hundred sides according to size. The flour should be stirred with water before it is used. The leather should be drummed in the flour for about two hours; then it is fat-liquored.

A suitable fat-liquor is made of soap and neatsfoot oil; or, better still, use acid fat-liquor dissolved in hot water, as described for alumina-tanned leather. From five to six pounds of the oil will fat-liquor one hundred pounds of chrome leather. Mix the oil into ten gallons of hot water and apply it to the leather after the flour treatment. Then hang the leather up to dry. When dry, dip the leather into warm water and place in a pile over night.

Finishing.—Stake the dampened leather; then mill it in a

closed wheel with powdered chalk or soapstone for one hour or longer; after which, stake the leather again and it is ready for use. Properly tanned and fat-liquored, the leather finishes up very soft and white and is admirably adapted to the purpose for which it is intended.

Good white leather can also be made by tanning the sides with alum, salt and flour, and then, after drying, dampening and fat-liquoring the leather with acid fat-liquor. White leather must be handled very carefully or it will become soiled and dirty. Chrome-tanned white leather is more satisfactory than alum-tanned if properly tanned and bleached.

CHROME SIDE PATENT LEATHER.

Hides for chrome-tanned patent leather should be carefully selected after they have been unhaired. The grain must be as near perfect as grain can be. Only small pattern and plump hides can be made into patent leather, as large, spready and thin hides are of loose texture when tanned. After the hair and fine hair have been removed, the hides should be washed from ten to twenty minutes in a wash-wheel. They are then ready to be bated. Hides intended for patent leather should be bated as low as possible in order that the leather may have fine grain and full feel. Bating, however, must be very carefully done. If the hides are bated too much the leather will be loose and break coarse; if not bated enough the grain will be harsh and tender. A thin grain is to be preferred to a thick one. The former will have more elasticity than the latter, and therefore be less apt to crack. After the hides are bated they should be washed a few minutes in warm water to cleanse the grain, and then pickled.

Pickling and Tanning.—For every hundred pounds of hides dissolve four pounds of sulphate of alumina and ten pounds of common salt in six gallons of boiling water; then add six gallons of cold water. Use this liquor cold and drum the hides in it one hour, then press or partly dry them for splitting. After the hides are split the grains can be shaved, and this will save

putting them out for shaving after they are tanned. The grains are then ready to be tanned.

Either the two-bath or the one-bath process can be used, but the latter is the best, as it gives more measurement and there is no sulphur to cause trouble after the leather is finished. Drum the grains in salt water; then give them the tanning liquor, and continue drumming until the leather is fully tanned. The leather can be washed, colored and fat-liquored in about the same manner that other chrome leather is treated, or it can be laid away for four or five days in one-bath chrome liquor. The layaway liquor is prepared by adding five gallons of chrome liquor to one hundred gallons of water. The leather is placed in this liquor and handled each day. The object of this is to make the leather softer than it would otherwise be, and thereby reducing the quantity of fat-liquor required. Hides placed in a layaway do not draw and shrink as much as leather not tanned this way. The leather requires the same thorough washing that all chrome leather requires. After washing, it is ready to be colored.

Coloring and Fat-Liquoring.—Coloring is done with logwood and striker. Only enough dye should be used to produce a good color; and all surplus dye must be washed out. Fat-liquoring is done most satisfactorily with degreas and soap, or degreas may be used alone. When soap is used, prepare a liquor by boiling one pound of soap to each gallon of water. Then for every hundred pounds of leather add two quarts of degreas to enough soap liquor to drum the leather in and run the leather in the fat-liquor forty-five minutes immediately after coloring. The leather is then struck out, oiled on the grain and hung to dry in a warm room. Drying should proceed rapidly so that the leather will dry firmer than when it is dried slowly. There are fat-liquors that can be used that make the leather sufficiently soft and dry without being degreased. Ordinarily chrome patent leather must be degreased before it is finished.

When degreas is used without soap, the fat-liquor is made as

follows: Dissolve four pounds of soda ash in the smallest quantity of water that will dissolve it. Pour the solution into ten gallons of water and let it come to boiling point. Then add twelve gallons of moellon degreas and boil steadily for four or five hours. Enough water should then be added to make forty-eight gallons of fat-liquor. Give the leather from three to five per cent. of this fat-liquor diluted with hot water and drum the leather in it for forty minutes; then oil and dry it. Too much fat-liquor makes the leather too soft and mushy. As a rigid and firm foundation is required to prevent the varnish from parting, the leather must not be made too soft.

Staking and Finishing.—When the leather is dry, dampen it with wet sawdust or hot water and give it a thorough staking; then tack it as tightly as possible. When the leather is taken from the frames it will be found to be sufficiently firm to be finished were it not for the grease in it that must be removed. Some of the grease given in fat-liquoring and some of the oil applied to the grain are not combined with the fibers and unless removed will cause the varnish to slip over the leather so that finishing becomes impossible. Degreasing is most satisfactorily done with naphtha. Where a great deal of leather is being made a naphtha plant must be installed or else the leather must be sent to naphtha works and degreased by those who make a business of extracting grease from leather. Degreasing can also be done by soaking the leather in naphtha for ten hours, then pressing out the naphtha and drying the leather. The action of naphtha on chrome leather is quite harmless and if the leather has been well fat-liquored and oiled no strength is lost through the degreasing operation. Sides for patent leather can be tanned with chrome liquor and then split to the desired substance and retanned. This improves their "break" of grain and softness of feel. Sulphide of sodium should be used with lime in preparing the hides for tanning. It gives the grain an appearance similar to coltskin, removes the fine hair and produces fuller and plumper leather than lime alone or lime and red arsenic. All fine hair must be removed as it is one of the worst

things to contend with in making patent leather. The sulphide of sodium can be mixed with pure milk of lime, say three ounces of the sulphide per side to a sufficient quantity of lime to process the sides in. When a drum is used the results of the process will be accomplished in five or six hours. The hides are then taken from the drum, washed, unhaired and then washed again before they are bated. This is only one of several methods that can be followed. Hides that weigh more than forty pounds are not suitable for patent leather.

· VEGETABLE TANNING PROCESSES FOR SIDE LEATHER.

In the manufacture of leathers from hides and kips that are finished upon the grain and intended for shoe purposes, various processes of tanning are employed. Hemlock bark and extract liquors are used, the sides after splitting being retanned with some other tanning material, such as gambier and palmetto extract. Hemlock extract is used in combination with quebracho liquor with excellent results. Hides are started in quebracho liquor and retanned with some combination of extracts. Palmetto extract is used alone, also in combination with quebracho extract. Gambier is one of the staple tanning materials. The leather it makes is soft and tough, and readily colored and finished in any desired manner. Good leather is also made by combining gambier with a chrome process.

The tanning is done in vats provided with paddles by which the liquor is stirred; also in pits or vats, in which the hides are suspended and not subjected to much agitation. The less agitation the hides are subjected to during tanning the fuller and plumper the finished leather is, especially in the flanks and along the sides. A common process of tanning consists of tanning hides with hemlock bark liquor until they are struck through, and then retanning the grains, after splitting, with gambier and sumac or with palmetto extract.

Several practical methods of tanning side leathers are outlined in this chapter.

Tanning with Hemlock and Quebracho Extracts.—One of the

best combination-processes that a tanner can use is a combination of quebracho extract and hemlock liquors. Hemlock is a rather harsh tannage when used alone, and so quebracho is nearly always used with it, which helps to make soft, pliable leather and a good color. Quebracho also hastens the tanning and reduces the cost.

The hides are limed, bated and washed and are then subjected to tan liquors, which are about two-thirds quebracho to one-third hemlock. This tannage can be used for tanning almost any variety of leather. The color is fair and uniform, and the reduction in the time consumed by the process is about one-third that required where bark liquors and layaways are used. The leather is readily colored any shade desired with very little or no bleaching. Where hemlock bark is not obtainable hemlock extract can be used in place of the bark liquor.

The sides should first be suspended in a weak coloring liquor, the proportions of the two extracts being one-third hemlock and two-thirds quebracho. The coloring should take about twenty-four hours. The sides are then taken out and placed in a liquor of a strength of about ten degrees barkometer. As the tanning progresses the liquor should be strengthened each day until its strength is about thirty degrees. The tanning should not be hurried by using too strong liquor as this makes harsher and less desirable leather than a slower process in rather weak liquor. When the sides have become well struck through with the tan, which takes eighteen or twenty days, they are removed from the liquor, pressed and split. The grains are then retanned with hemlock and quebracho liquor, with palmetto liquor, with a mixture of gambier and sumac; sometimes retanning is necessary, depending upon the condition of the leather.

Tanning with Quebracho and Palmetto Extracts.—A combination of these extracts makes full, plump and mellow upper leather. No hard nor fast rule can be laid down for the proportions of the two extracts but a liquor three-fourths quebracho

and one-fourth palmetto will produce satisfactory leather. Both of these extracts are rapid tanners and the tanning may be completed in a comparatively short time. The combination may be modified according to the results that are obtained and the class of leather that is being made.

Quebracho extract contains a large percentage of tannin and a small percentage of non-tannin. Palmetto extract contains a large percentage of non-tannin and a low percentage of tannin. By combining the two a good tannage is obtained that penetrates rapidly and produces mellow and well-filled leather that can be easily colored or dyed black and finished in smooth or boarded finish. The hides are colored in a weak liquor, then transferred to a stronger liquor which is strengthened from day to day until the hides are tanned. Splitting and retanning completes the process. Retanning can be done with a combination of the two extracts or palmetto may be used alone.

Tanning with Palmetto Extract.—A practical way to tan sides with palmetto extract is carried out in the following manner: The tanning is begun by nailing the sides on sticks and immersing them in an extract liquor beginning at 12 degrees barkometer and ending at 20 degrees, the time being about six days. Care must be taken to color every part of the hides alike. The sides are then taken off the sticks and passed into a 30-degree Baumé palmetto liquor. In this liquor they should be handled twice each day so that the tanning may be uniform. In about six days the sides are tanned through; they are then pressed and split. The retanning is done with a weak palmetto liquor 12 degrees B \acute{e} ., followed by a drumming in a 30-degree liquor for six hours until thoroughly tanned. The grain is made tough and strong and not loose or liable to "pipe."

The grains of sides split out of lime can be readily tanned in a drum, also kips and light hides. They are started in a weak, cold palmetto liquor for one hour, the strength of which may be about 10 degrees barkometer. They are then tanned in a drum with a liquor 30 degrees B \acute{e} ., 51 Twaddell, at a temperature of 75 degrees Fahr. For seven hundred pounds of hides

four hundred and fifty pounds of extract are used. In from six to eight hours the stock will be tanned. It is then split or shaved and retanned with a 10-degree liquor. The leather may also be retanned in a drum for one hour with liquor 30 degrees Bé., 51 Twaddell, after which it is washed in lukewarm water. The water used for this washing may be used for coloring a fresh pack of hides as they come from the beamhouse. The leather is then pressed and fat-liquored with soap and degreas or other suitable fat-liquor and dried. The dry leather is then sorted and finished into black or colored leather. For colored leather it is advisable to retan with sumac and then apply the color.

Tanning with Gambier.—The sides are started in weak liquor which is gradually strengthened by the addition of fresh gambier until it becomes fairly strong towards the end of the process. Common salt serves a useful purpose in gambier tanning. It assists in making soft leather, in hastening the tanning process, and it prevents contraction of the leather fibers. It is well for the tanner to divide his tanning liquors into three sections. In the first section the hides are colored; in the second section the tanning goes forward until the leather is ready for splitting; in the third or last section the retanning or tanning after splitting is done.

At the beginning the liquor may be four to five degrees barkometer. The liquor should be strengthened twice each day, the quantity of fresh liquor that is added depending upon the size of the vats and the strength of the liquor at the start. No exact rule can be laid down as the tanner must decide this and other questions by his judgment. The tanning should go forward steadily until the hides are tanned through; then they should be split, retanned and fat-liquored.

Combination Process.—An excellent tanning process in which hemlock, chestnut wood and quebracho extracts are used for tanning and quebracho and gambier or quebracho and palmetto extracts are used for retanning is carried out in the following manner: The hides are hung on sticks in a seven-degree hem-

lock liquor. They are handled every day for three days, the liquor being strengthened up to ten degrees and finally up to twelve degrees. After the sides have been in the twelve-degree liquor twenty-four hours, they are passed into a sixteen-degree combination liquor, made of chestnut wood extract and quebracho. This liquor is gradually raised to twenty degrees, the process requiring fourteen to sixteen days. The sides are then pressed and retanned. The retanning liquor is made up of quebracho and gambier or quebracho and palmetto extracts. The strength should be twenty-six degrees and the liquor three parts quebracho and one part gambier or palmetto. The grains are drummed in this liquor one hour, then left in piles for twenty-four hours, drummed again for one hour, piled down twenty-four hours, then washed and finished. This is a good tannage for many varieties of leather, such as bag and case, as well as upper. As described above it is most suitable for large heavy hides.

Pressing and Splitting.—Before leather is split it is necessary to press it to get rid of the surplus liquor in it and to put it in good condition for splitting. Considerable moisture should, however, be left in the leather. When it is pressed too dry, the leather must be milled in a weak liquor to prepare it for the strong retan liquor and this milling pounds the grain and makes it loose and pipy. When there is considerable moisture in the grains they do not need to be milled in a weak liquor but can be put at once into the retan liquor. The more moisture there is in the grains the better the results will be.

Retanning Processes.—Leather that has been tanned in hemlock or combination liquors, no matter how it is to be finished, is improved by being retanned with gambier and sumac or with gambier and hemlock extract.

Hemlock has excellent filling properties but it makes the leather somewhat harsh, and the black on such leather turns to a dull gray-black after a time. When the leather is retanned with gambier, the flanks are made fuller and firmer, the fibers are slightly contracted, the harshness is toned down, the leather

is given a smooth feel and the color is less apt to fade. The retanning is done, of course, after the leather is tanned, pressed and split.

The retanning is done most expeditiously in a drum, and in the following manner: Boil in eighty gallons of water, two hundred and fifty pounds of gambier. When the liquor has become fairly cool, skim off all foreign matter. Ten gallons of this liquor are sufficient for thirty average sides of leather, and the liquor is put into the drum with the leather and to it are added two gallons of dry sumac and as much water as is needed to make the leather wet without dripping. Run the leather in the gambier-sumac liquor for from thirty minutes to one hour. It should then be left in piles for twenty-four hours; then scoured or washed, fat-liquored or dried, according to the kind of leather that is being made. Gambier and sumac used in this way improve the quality of the leather by making it firmer, tougher and more mellow.

Palmetto extract may be used in place of gambier and sumac. Oak extract also produces results similar to gambier.

Gambier, hemlock and alum make a good retannage for hemlock-tanned leather, especially bark-tanned kangaroo. The proportions of gambier and hemlock should be equal parts of each, the liquor being 25 degree barkometer. Twenty-five sides should be given four pails of the liquor and four pounds of alum dissolved in two gallons of water. Run the leather in this liquor for forty-five minutes, then pile it down over night and then hang it up to dry. When it is dry, the leather may be fat-liquored, colored and finished.

Retanning with gambier and sumac may also be done as follows: Boil two pails of good sumac in forty gallons of water for fifteen minutes and allow the liquor to stand over night. The next day boil twelve and one-half pounds of gambier. Add the gambier liquor and ten pounds of salt to the sumac liquor. There should be fifty gallons of liquor. Drum fifty sides of leather in this liquor for one hour, the temperature of the liquor being 80 degrees Fahr. Then place the leather in

a pile for twenty-four hours, after which rinse it in warm water to wash off the spent sumac. This is a good retanning process for bark or extract tanned leather. Bark-tanned sides should be washed in warm water to which some salts of tartar have been added before they are retanned. After the retanned leather has been rinsed off it may be fat-liquored and dried or dried, then dampened and fat-liquored.

Palmetto extract used alone and also in combination with quebracho makes a good retanning process. A combination of seventy-five per cent. quebracho and twenty-five per cent. palmetto is recommended for upper leather; also one of seventy-five per cent. quebracho and twenty-five per cent. gambier.

One pint of bisulphide of soda added to each three gallons of retanning liquor helps the liquor to penetrate into the leather more quickly. The strength of the quebracho-palmetto and of the quebracho-gambier liquor should be from 24 to 28 degrees. Any one of these processes may be used in the retanning of hemlock and combination-tanned leather for colored and black upper leather, dull or bright printed grains and imitation kangaroo.

Clearing the Grain with Alum and Salt.—Leather that is to be colored and finished into Russia leather is strengthened and cleared by being run in a drum in a solution of alum and salt. In thirty gallons of water fifteen pounds of alum and ten pounds of salt are dissolved. This quantity of liquor is sufficient for one hundred and twenty sides that have been retanned and washed. The leather is drummed in this liquor for thirty minutes; it is then allowed to drain off and is then pressed and fat-liquored and dried; or it may be drummed in the alum and salt liquor immediately after retanning, and then be washed and dried and dampened and fat-liquored at some later time. The solution of alum and salt clears the grain and improves it so that it will subsequently color more evenly and be stronger. This treatment is not advantageous for black leather, but it is of some value when the leather is colored light and fancy shades.

COLORING AND FINISHING VEGETABLE TANNED UPPER
LEATHER.

Excellent results are obtained in the finishing of dull and glazed boarded grain leather, imitation kangaroo and black and colored Russia leather by giving the sides two applications of fat-liquor, one before and one after coloring. The outline of the process is as follows: After the leather has been split, re-tanned, pressed and shaved it is sammied and then weighed for the first application of fat-liquor. The drum is heated with live steam to 125 degrees F., and the leather is put in with a small quantity of water also heated to 125 degrees F., and drummed until the moisture is evenly distributed and the leather fulled. The fat-liquor is then rapidly and evenly absorbed. Another way to moisten the leather is to dip it into warm water and place it in piles until it is softened through. This is less apt to pipe the grain than dampening in the drum. An excess of moisture in the drum or in the leather must be guarded against, as it prevents the proper absorption of the fat-liquor.

The fat-liquor should be used at a temperature of 125 degrees F. It should be poured into the drum through the hollow axle while the drum is in motion. A drumming for thirty minutes enables the leather to absorb all the fatty matter in the liquor, provided the leather and liquor have been properly prepared and used.

After the leather has received the first application of fat-liquor, it is rinsed off in clean warm water to free it from particles of leather fiber and fleshings which, containing oil, are apt to spot the leather while it is drying. Before the leather is hung up to dry, it should be placed on a horse for about four hours, which will allow it to drain and the fatty matter to assimilate with the tannin and to penetrate while warm into the stock. The leather is then hung up and dried.

When leather is given two applications of fat-liquor, the first application should be at least half of the whole quantity used. Colored Russia leather can be given no better fat-liquor than

sulphated oil. This material is also good for black leather. Any good fat-liquor of soap, oil and degreas, however, can be used, but the ingredients must be thoroughly emulsified and of the best quality.

Glazed and boarded grain leather is colored blue upon the flesh before the second application of fat-liquor and blacked upon the grain afterwards, although some tanners color flesh and grain at one operation.

Colored Russia leather is usually bleached, mordanted and colored before second application of fat-liquor.

After the leather is dry from the first application of fat-liquor, it is dampened and colored, then dried and dampened again for the second application of fat-liquor. Imitation kangaroo and dull grains are usually yellow-backed before the second fat-liquoring. After being fat-liquored the leather is dried again for finishing. Kangaroo calf and sides are sometimes fat-liquored and dried, then yellow-backed, grain-blackened, dried and finished.

Palmetto and quebracho-palmetto tanned leather may be washed after retanning, pressed and fat-liquored with oil and degreas and dried; it may then be dampened, colored, dried and finished.

All kinds of combination-tanned sides can be handled in the following manner with satisfactory results: When the retanning is completed, the sides are washed and pressed to remove surplus liquor. Some tanners merely press thin leather and do not wash it. After pressing, the sides are shaved and fat-liquored. In some cases the leather is drummed in oil and dried before it is fat-liquored. This is a good method to follow in finishing colored leather. A drum is heated with steam to 100 degrees Fahr., and one gallon of oil is used for each one hundred and fifty pounds of leather, weighed after pressing and shaving. The leather is run in the oil for forty minutes, then hung up and dried. A small quantity of sulphated oil is recommended for this purpose, although any good oil may be used. After drying, the leather is weighed

and dampened with warm water and placed in piles to soften. Then it is put into the drum and run with just enough water to soften all parts alike, when it is in condition to receive the fat-liquor. This method is pursued by some tanners, while others omit the oil and fat-liquor their leather after it has been drained and pressed. It is also good practice to run leather for colors in sulphated oil, then dry and color it and then fat-liquor it with the main fat-liquor.

To fat-liquor leather, the drum should be heated with live steam to a temperature of 125 degrees Fahr., and the leather should be drummed in warm water until soft and full. The fat-liquor should be given to the leather in portions of one or two gallons at a time through the hollow gudgeon; and after all the fat-liquor is in, the leather should be drummed for forty minutes. Upon being taken out of the drum, the leather should be rinsed in clean warm water, drained and dried. When dry, the leather may be colored blue on the flesh and black on the grain or yellow upon the flesh and black on the grain, or it may be colored any shade with aniline dye, dried and finished with smooth or boarded or printed grain or into imitation kangaroo leather.

After leather has been fat-liquored and dried, it is advisable to let it lay in the dry condition for a week or longer to mellow before proceeding to color and finish it. As a fat-liquor for combination-tanned leather any one of the following formulas may be used.

Fat-liquor Formulas.—1. Boil twenty-five pounds of potash soft soap in twenty-five gallons of water until dissolved. Then add to the soap fifty pounds of English sod oil and one and one-half gallons of neatsfoot oil and stir for five minutes. A few pounds of moellon degreas may also be added. Enough cold water is next added to make fifty gallons of fat-liquor. Twenty gallons of this fat-liquor will fat-liquor one hundred pounds of dry leather that has been run in oil before drying. The exact quantity to be used varies with the different tan-nages, as some require less than others. The quantity stated

is the maximum. A smaller quantity will in some cases produce the desired results. This is a good fat-liquor for colored or black combination tanned leather.

2. Five pounds of soap and one gallon of moellon degreas boiled and made into a fat-liquor with one-half barrel of water. This quantity of fat-liquor is sufficient for four hundred pounds of leather palmetto or quebracho-palmetto tanned. It may be applied to the leather after tanning or the leather may be drummed in oil, dried and then fat-liquored, dried and colored.

3. A good stuffing for imitation kangaroo and dull printed sides is made of twelve pounds of German degreas, twelve pounds of oleo stearine, five pounds of fish oil to each one hundred pounds of leather, dried after retanning and weighed after being dampened. Use at 130 degrees F. Pack down over night to harden, then set the leather out by hand and hang it up to dry. When dry, buff off the grain, trim and stake the leather; then dye the flesh yellow, black the grain and finish the leather.

4. For hemlock, hemlock-quebracho and quebracho-palmetto tanned leather the following fat-liquor is recommended: Ten pounds of soap, four gallons of neatsfoot oil, ten pounds of degreas to the barrel of liquor. Use at 125 degrees F., preferably after coloring, then set the leather out, oil the grain and dry the sides out. The leather, dried after retanning, is dampened and colored. The surplus water is then pressed out and the leather is fat-liquored. Heat the drum with live steam, drain out the condensed steam and run the leather in the warm drum a few minutes. Next add the fat-liquor, not more than a pailful at a time at intervals of five minutes, then another pailful, until the quantity is in the drum; then let the drum run for forty minutes to give the leather time to absorb the fatty matter. Remove from the drum and horse up for some hours, then strike out; oil the grain with neatsfoot oil and then hang the sides up or tack them on frames to dry. Ten gallons of this fat-liquor is enough for twenty-five sides of twenty-foot, four-ounce leather. It is best to use this process after the leather has been dyed black or colored.

5. For bright printed or boarded grains another good fat liquor is: Twelve pounds of pure cod oil, two pounds of French degreas, two gallons of thin, soft soap for one hundred pounds of damp leather. Apply at 125 degrees Fahr. The leather, after it is retanned, should be drummed for one hour in strong, warm sumac liquor, then rinsed, scoured on both sides and hung up to dry. When dry, dampen and fat-liquor with the liquor described above. After fat-liquoring, set the leather out and apply a light coat of oil to the solid part of the flesh side after it has been set out. The leather should be set out very tightly on both sides, since the tighter it is set, the finer and more even the grain is after the leather is finished. After the leather is dry, it is dampened and blacked with logwood and striker, dried again and then staked and finished.

Receipts for Yellow Flesh.—After the leather that is to be finished into imitation kangaroo has been fat-liquored and dried, the flesh can be colored yellow by using five pounds of turmeric, one pound of sal soda, one pound of borax, one gallon of neats-foot oil boiled in ten gallons of water; then fill the barrel up with cold water and use twelve pails of the liquor for a drumful of leather. After the flesh has been colored, dry the grain with sig, logwood and iron liquor; wash the leather and dry it out.

Yellow flesh can also be obtained by using yellow aniline dye. The leather is dampened and placed in piles to become soft. One half pail of sumac is scalded for two hours in a closed vessel. To the prepared sumac four pails of water and one gallon of lactracine are added. This quantity of liquor suffices for sixty medium sides. It is used at 100 degrees Fahr., and the leather is drummed in it for twenty-five minutes, when it is ready for the yellow dye. Yellow S is a good dye to use. One pound of the same is dissolved in twenty-five gallons of water and applied to the leather at 100 degrees. The leather is then blacked on the grain, oiled off and dried. Four pails of the yellow dye will color one hundred pounds of dry leather.

Receipts for Blue Flesh.—To obtain a dark blue or black

flesh, drum the leather in an alkaline logwood and fustic liquor, then apply iron striker either in the drum or by hand or on the grain side only. Or use the following process: Drum the leather in a solution of five or six ounces of titanium-potassium oxalate for one hundred pounds of dry leather for ten minutes, then pour alkaline logwood liquor into the drum and run the drum fifteen minutes; then pour in another solution of titanium salts just like the previous one and run the drum ten minutes longer. Wash and finish the leather. If the leather is to be fat-liquored twice, give it the second fat-liquor after coloring and then dry it for finishing.

To get a dark blue flesh with nigrosine, use eight ounces of the dye for each dozen sides. The dye is boiled in a few gallons of water and the leather is drummed in the solution for twenty minutes. The grain is then blacked with logwood and striker and the leather is dried out. A flesh color can also be obtained by using logwood liquor, to which nigrosine black and methyl violet aniline have been added.

Finish for Bright Boarded Grain Leather.—Dissolve in three gallons of soft water, four ounces of logwood extract and four ounces of gelatine; when cold, add two ounces of ammonia, one gallon of beef blood, one pint of new milk, two ounces of muriate of iron, and two ounces of spirits of camphor. Mix one ounce of glycerine in milk before putting into the finish; then mix together, putting in the iron and camphor after the other ingredients have been worked together. Stir thoroughly after all the articles are together.

The dry leather should be dampened, staked and tacked. Then dampen the grain before finishing with warm, weak logwood liquor. As soon as the grain is dry, apply the first coat of seasoning, dry the grain and then polish with the jack. After polishing, dampen the leather, and let it lie a while to allow the dampness to penetrate evenly; then grain from tail to foreshank and from hindshank to top of shoulder, and soft board crosswise on the flesh side. Let the leather dry, and then finish graining by boarding on grain side crosswise and

lengthwise. Then apply two very light coats of seasoning, the first being dried before the second is applied. After the last coat is dry, the leather is ready for the last polishing. Sufficient pressure should be used to cause the grain to disappear and to bring the brightness from the bottom of the impression of the print. After the polishing, the leather should be staked and then given the last graining. Grain four ways on the grain side, very lightly, and the result will be a fine, even grain, very black and glossy. The finishing touch is a light coat of hot oil, made of equal parts of raw linseed, paraffin and sweet oils. After being oiled, the leather should lie in a pile for a few days before it is assorted and rolled into bundles. Leather that is properly tanned and fat-liquored and then finished in the manner described leaves nothing to be desired in the way of softness, color or finish. Dull boarded leather is made in about the same manner, with the exception that a dull seasoning is used. Printed grains are made by printing and graining the leather with the grain figure that is wanted.

Finishing Bark-tanned Kangaroo Side Leather.—Bark-tanned sides that have been retanned with gambier, hemlock and alum should be dried and fat-liquored with degreas, stearine and fish oil, then dried and the grain buffed. The flesh is then colored yellow and the grain is blacked with logwood and copperas and given a coat of paste made of two quarts of flour, ten quarts of water, eight ounces of tallow, four ounces of beeswax, two quarts of linseed oil. Boil these ingredients one-half hour, then add eight ounces of soap, three ounces of black nigrosine and boil fifteen minutes. Thin down with water and apply a fair coat to the leather; when dry, roll. A suitable finish is made of: Casein, one and one-half pounds; olive-green soap, one and one-fourth pounds; tallow, one-half pound; German degreas, one-half pound; fish glue, one and one-half pounds; black nigrosine, one-half pound. Boil one hour, cool and add one pint of ammonia and strain. This when done will make six gallons. Now make up in another tub the following: Irish moss, one and three-fourths pounds; olive-green soap,

one and one-fourth pounds; borax, one-half pound; flour, two pounds; nigrosine, one-half pound. Boil one and one-half hours, cool and strain. This when done will make six gallons. Mix one-half of the first and one-half of the second, finish and use it on the machine. It will give a medium bright finish. If the finished leather is too bright, use more of the moss finish. If a bright finish is wanted, omit the moss finish. Give the leather two coats of finish on the machine, and when dry, roll. If boarded kangaroo is wanted, the sides should be boarded before any paste or finish is put on.

Some tanners prefer to give their kangaroo sides a light stuffing or fat-liquoring, then to dry them, dampen and color the flesh yellow, then to give another application of fat-liquor and to color the grain with logwood and copperas after the second fat-liquoring. Others color their leather yellow on the flesh and black on the grain before the second application of fat-liquor. Any method may be used that produces the results that are wanted.

A sig to be used on kangaroo sides may be made of twelve ounces of caustic soda and twelve ounces of salts of tartar boiled in ten gallons of water; then fill the barrel up with cold water. This is used to cut the grease out of the grain so that the dye can penetrate.

A logwood liquor is made by boiling seventy-five pounds of chip logwood for two hours in eighty gallons of water. When done there will be one barrel of liquor. Before using, add one and one-half pints of ammonia and use at 105 degrees F.

A black or striker is made of eight pounds of copperas, two and a half pounds of bluestone, one pound of nutgalls, four gallons of logwood liquor boiled in fifteen gallons of water. Fill the barrel with cold water and then add eight ounces of tincture or muriate of iron.

Coloring Side Leather.—Leather that has been tanned in a combination of vegetable tanning extracts such as quebracho and palmetto or quebracho and hemlock or that has been tanned with one tanning extract and retanned with another or

combination of extracts can be colored and finished into satisfactory leather by several methods of handling and treatment.

The sides, when retanned, can be washed, pressed, fat-liquored and dried; then dampened and colored, refat-liquored, dried and finished.

Another way consists of fat-liquoring the leather, drying it out and then dampening, coloring, drying and finishing it.

Good colored leather is also made by drying the leather, then coloring and fat-liquoring it and then drying it for finishing.

For colored Russia leather a fat-liquor of sulphated oil is recommended. The leather may be given an application of the oil, then dried and colored and after coloring it may be again run in a solution of the oil, then dried and finished. Leather that is dark from the tan must be cleared and bleached before it is colored, but leather that is clear and light-colored needs no bleaching, although it is advisable to drum it in sumac either after tanning and before drying or after the leather has been dampened for coloring.

To color one hundred pounds of dry leather use eight ounces of titanium salt. Dissolve the salt in warm water and drum the dampened leather in the solution for ten minutes; then run the liquor out of the drum and put in the solution of aniline dye, and after running the leather in this until colored wash it and fat-liquor or refat-liquor it and dry it for finishing.

A process of preparing the sides for Russia leather with sumac is carried out in the following manner: Wet the dry leather in a tub of warm water and place it in a pile for twenty-four hours to soften. Take one-half pail of sumac and scald it for two hours in a closed vessel. Add to it four pails of water and one gallon of lactracine, and put the prepared liquor into the drum with sixty medium sides. Have the temperature at 100 degrees Fahr., and run the leather in the liquor for twenty-five minutes; then drain the liquor out and run the leather in the color solution until it is colored the right shade, then rinse it, fat-liquor and hang it up to dry.

Retanning with sumac is advisable for almost every tannage

of leather. As it is done just previous to coloring it freshens up the leather and prepares it to take the dye. After being drummed in sumac, the leather is preferably treated with titanium salts and then colored with aniline dye. This process of coloring combined with proper fat-liquoring with sulphated oil or oil and soap produces excellent colored leather.

VEGETABLE TANNED PATENT SHOE TIPPING.

The tanner who makes chrome leather from hides can realize greater profits from their poor-grained hides by working them into vegetable-tanned tipping than by allowing them to go through the works and then be sold for No. 3 chrome or as a job lot of culls.

Good, strong tipping requires more liming than chrome leather. If the tanner will sort his hides after they are unhaired, he can have an extra lime-pit and make up a medium strong lime liquor, and all damaged grain hides can be put into this lime for from 24 to 48 hours, then put through the regular system of washing, working on the grain, bating, etc.

After they are bated down well (tipping hides should be bated low, so as to make soft, strong leather) they should be started to tan by tacking on sticks and suspended in a weak sour liquor. If a non-acid tanning agent is being used, the liquor should be turned to the acid side by the use of lactic acid or Dermiforma. The first liquor should stand about 7 degrees test with a barkometer. Allow the hides to remain in this sour liquor 48 hours, then handle them over into another pit, or else draw off the sour liquor and pump on a fresh sweet liquor of 10 degrees strength. If they are handled over into the next pit, they should be pulled out and laid in a pile to drain for two hours, in order that they will not carry too much of the sour liquor into the next pit. Allow the hides to remain in the 10-degree liquor 48 hours, then work them into a 12-degree liquor for 48 hours. Now work them into a 16-degree liquor and allow them to remain four days, but they must be handled each day and their position changed, so that they will

not have any raw or kissed spots on them. After they have been in the 16-degree liquor the required length of time, the hides are worked into a 20-degree liquor and allowed to stay six days, when they are pulled from the sticks and allowed to lie in a pile for 48 hours. The hides are then pressed or put through a wringer so they will be in condition for splitting, or they can be run through a splitting machine with a corrugated roll without pressing or wringing. If they are pressed or put through a wringer they must be jacked on a stoning-jack to remove all marks.

After they are jacked they are split at a $2\frac{1}{2}$ -ounce gauge and the grains are then retanned in a mill with sumac, using two pails of sumac to each dozen medium-sized sides. Boil the sumac in about twenty gallons of water and allow to stand until cool, then put in the leather and run from one to one and one-half hours; then take the leather out and put it into a pile for twenty-four hours. Then give the leather another run in sumac liquor made the same way. The leather is piled down again and allowed to lie twenty-four hours. It is then dipped in a tub of warm water to wash off the sumac and after that it is scoured on the table. While it is on the table, give the leather a good coat of moellon degreas slush, made up by dissolving four ounces of salts of tartar in three gallons of hot water and then stirring into the water two gallons of moellon degreas. The leather is given a light coat of this slush, well rubbed in with a brush. It is now folded together and laid in a pile for 24 hours, and then tacked out on frames. When dry it is buffed by hand, and either staked or soft boarded and pin blocked to soften, when it is ready to japan. Leather treated in this way does not require degreasing, provided a first-class moellon degreas is used.

Another Retanning Process.—A good way to fit bark-tanned leather for patent shoe tipping is to split and shave it on the machine, then for fifty medium-sized sides dissolve three pounds salts of tartar (carbonate of potash) in fifty gallons of water 80 degrees Fahr., and run in a mill for one-half hour, then drain

and wash for fifteen minutes, when the leather is in good condition for retanning.

The retan liquor is made as follows: Boil two pails of sumac in forty gallons of water ten minutes, allow to stand over night. In the morning dissolve twelve and one-half pounds of gambier and ten pounds of salt and add to the sumac liquor. There should be fifty gallons in all. Run the sides in this retan liquor one hour, using the liquor at 80 degrees Fahr., then pile down on floor for twelve to twenty-four hours and then throw into a tub of water to wash off the spent sumac.

The fat-liquor is made of soap, cod oil and moellon degreas. Boil one pound of fig soap until dissolved, add four and one-half pounds of cod oil and boil one-half hour, then turn off steam and stir in four and one-half pounds of moellon degreas of the best grade and mix thoroughly. Now add four ounces of salts of tartar dissolved and fill the barrel with water to make fifty gallons of fat-liquor. Use at 110 degrees Fahr. Run the leather in the fat-liquor for half an hour, then put it out and tack it on frames; when dry, buff the grain and stake. This process makes strong, fine tipping leather that can be easily japanned.

THE MANUFACTURE OF BAG AND CASE LEATHER.

The first essential in the manufacture of bag and case leather is good hides, preferably green-salted, that are clear on the grain and free from butcher cuts. When the hides are selected, trim off the heads and shanks and put the hides into clean soft water. The best way to soak the hides is to suspend them in the water and allow them to hang twenty-four hours; then take them out or run off the water and fill the vat with fresh water and soak the hides twenty-four hours longer. Then split the hides into sides, taking care to keep the backs straight. Five pounds of borax dissolved and added to one thousand gallons of water helps materially in softening and cleansing the hides. After the hides are split into sides, they are fleshed. The sides are then put into clean cold water over night, then put into lime.

Liming.—Liming usually requires six or seven days. Eight pounds of lime and two pounds of sulphide of sodium for one hundred pounds of hides are sufficient. The first lime should contain one and a half pounds of lime. Add the lime, thoroughly slacked, to the water in the pit or vat and plunge it well. Then reel the sides into the liquor, taking care to spread them out well. After being in this lime twenty-four hours, the sides should be reeled into the second lime, which should contain the same quantity of lime as the first lime. The third lime also should contain one and one-half pounds of lime for one hundred pounds of hides; and after being in the second lime twenty-four hours, the sides are reeled into this, and left in the same twenty-four hours; they are then passed into the fourth lime, and after twenty-four hours, they are put into the fifth lime. The liquor in this lime should be warmed to 65 degrees Fahr. before the sides are put in, and it should contain one pound of lime for each hundred pounds of hides. The sixth lime, into which the sides should be reeled after being in the fifth lime twenty-four hours, should contain one pound of lime and two pounds of sulphide of sodium for one hundred pounds of hides. This lime should be heated to 75 degrees Fahr. and the hides allowed to remain therein for twenty-four hours, and then be passed into warm water. After lying in the warm water two or three hours, the sides are in condition to be unhaired.

The sulphide of sodium should be dissolved in a barrel and the solution allowed to settle before it is used. The clear liquor is then mixed with the lime. Dissolving the sulphide this way is for the purpose of preventing dark stains on the hides, due to iron in the sulphide. After the hides are unhaired they are washed with running water for fifteen minutes, then placed in water at 80 degrees Fahr., after which they are worked by hand over the beam and then put into the bate.

Liming can also be done by immersing the hides in a solution of sulphide of sodium, six degrees barkometer, for three days, hauling them out each day and plunging the liquor. After the hides have been in the liquor three days, they are

washed with warm water and then limed two or three days, being handled at least twice, and using two pecks of lime for every one hundred sides. They are then washed and bated.

Bating.—This process should be accomplished by using either a bacterial bate or one made of sour glucose and lactic acid, as described for chrome side leather. The hides require a clean bate so as not to become stained, and they need to be well bated so as to have a soft and clear grain.

Pickling.—For every hundred gallons of water in the vat use thirty pounds of salt, and when this is dissolved add ten pounds of salt and one and one-half pounds of sulphuric acid for each hundred pounds of hides as they come from the bate. The sides may be run in the liquor two hours, then left in over night or several hours, and then placed over horses to drain for twenty-four hours before they are tanned.

Tanning.—Hemlock and quebracho extracts used in conjunction make an excellent tanning process for bag and case leather. The liquors are preferably about two-thirds quebracho and one-third hemlock. The sides are nailed on sticks and suspended in a weak coloring liquor for about twenty-four hours. This produces plumper leather than a paddle vat. The sides are then put into a liquor of about 10 degrés barkometer. Each day the liquors are strengthened until they are about 30 degrees. When well struck through with the tan the sides are pressed and split. The grains may be retanned in a drum with hemlock-quebracho liquor or with palmetto liquor, and then colored and finished. Tanning with hemlock and retanning with a combination liquor is done as follows: The sides are tacked on sticks and hung into a seven-degree hemlock liquor. They are handled every day for three days, and the strength of the liquor is gradually raised to ten degrees. After being in a twelve-degree liquor twenty-four hours the sides are put into a combination liquor made of chestnut-wood extract and quebracho extract. The strength at first is sixteen degrees, but this is gradually raised to twenty degrees, taking sixteen days to do it. The leather is then pressed and split; the grains

then retanned. The retanning liquor should be three parts quebracho and one part gambier; strength about twenty-six degrees and the leather milled in it one hour, then placed in piles for twenty-four hours, after which it is in condition to be bleached and colored.

Another good tanning process consists of two-thirds hemlock and one-third oak bark. The hides are first colored in a sour liquor, then put into the tan liquor seven degrees barkometer, handled each day, and liquor added until the tan is ten to twelve degrees. When well struck with the tan the hides are pressed and split. Retanning is done with either quebracho and sumac or quebracho and gambier. If the former is used the liquor should be twenty degrees barkometer, two-thirds quebracho and one-third sumac. Running the leather in this liquor one hour accomplishes its retannage, after which it is ready for coloring and finishing.

It is sometimes advisable to drum the sides in a solution of borax and then in an oxalic liquor after they are split and before retanning in order to clear the grain and bleach it. The leather is first run in a borax solution for twenty minutes and then washed. It is then run in a solution of two pounds of oxalic acid in fifteen gallons of water for ten minutes, then washed free of acid and retanned.

The usual practice, however, is to bleach leather that requires it, after it is retanned. The leather should not be pressed too hard for splitting. The more moisture there is in the grain when retanned the better the results are. When leather is pressed dry for splitting the grains should be milled in weak liquor before they are retanned, and this extra milling makes them loose and pipey. One quart of bisulphide of soda added to each six gallons of retan liquor helps the liquor to penetrate more quickly. Excellent leather is made by tanning the sides in a one-bath chrome process, then washing and retanning them. Retanning is then done with quebracho and chestnut oak extract in the proportion of three parts of the former and two parts of the latter. The liquor should be twelve degrees

barkometer at the start, strengthened to eighteen degrees the next day, and to twenty-four degrees on the third day. Each night the hides should be taken out of the liquor and piled down until the next morning; then put into the strengthened liquor. After retanning for three days, the sides are placed in a pile until the next day, when they are pressed and split.

Bleaching and Coloring.—From twenty-five to thirty sides, after retanning, make a convenient sized pack. A solution of six pounds of borax in twenty-five gallons of water is put into the drum with the sides and the drum is run fifteen minutes. The temperature of this bath should be 110 degrees Fahr. The leather should then be rinsed with warm water and then given a bath of sulphuric acid. Add two quarts of the acid to twenty-five gallons of warm water and mill the leather in the solution fifteen minutes. Then the acid bath is drained off and the leather is thoroughly washed until all acid is washed away. A sumac bath is prepared by boiling two pails of sumac in about eight pails of water, and the leather is drummed in this thirty minutes, then rinsed in clear warm water, slicked out on the flesh and then colored.

Some tannages require more bleaching than others. Hemlock and quebracho make a nice clear, light-colored leather that needs very little bleaching. Treatment with sumac is always beneficial to leather that is to be colored.

Fat-liquoring with soap and egg yolk or with soap and degreas is done after the leather is colored. The leather is then drained, slicked out on the flesh and grain and tacked on boards to dry.

Finishing Rough Leather.—Rough leather selected for bag and case leather should be of a nice light color, of soft tannage and free from scratches, grubs, salt and bark stains. The best results are secured from sides that measure when finished about twenty-four feet. Fourteen pounds weight to the side should be the limit. The rough leather should be weighed and trimmed. Twenty-five sides make a convenient-sized pack. Wet them down over night and then stone them out on the jack in the morning. Skive them on the belt knife machine and then

split them from two to four and a half ounces per foot. The lighter leather will be most suitable for suit cases and the heavier leather for bags.

The next process is washing with borax preparatory to bleaching. If the leather is dark, dirty and greasy, more borax is required than for light, clean stock. Use twenty-five gallons of warm water and from one to six pounds of borax for the twenty-five sides. Run the leather in this borax solution fifteen minutes. Then drain off the water and wash the leather in warm water to remove the extra tannin and the borax. The leather is then ready for the acid bath.

Mix one gallon of sulphuric acid into thirty gallons of water and run the hides in the solution ten minutes; then drain the liquor out of the drum and wash the leather with three or four changes of water, using at least twenty-five gallons at each change. The leather should be washed until no trace of acid can be detected by the taste in the water coming from the drum. More or less acid may be used according to the requirements of the leather.

Next have the drum clean and empty. Put the sides into it with a strong and hot sumac liquor and drum them in it for one-half hour. Some tanners add a teacupful of tin crystals and a cup of muriatic acid to the sumac liquor, others add only salt. Take the leather out and place it in piles for twenty-four hours; then rinse it in clear warm water to wash off the sumac and strike the flesh out hard. If the sides are to be colored in a drum, they are now in good condition for the process. If they are to be dried first give them a coat of cod oil on the grain and tack them on frames to dry.

The leather should be run in the color bath thirty minutes, then rinsed and horsed up. One way to treat it is to hang it up to dry after rinsing without setting it out, as setting works the dye into the flanks and sides. After the leather is dry it may be dampened, set out on the grain, given a light coat of oil and tacked on frames to dry. Another way consists of fat-liquoring rather lightly after coloring, using fig-soap and egg-

yolk in equal proportions; then horsing the leather up for twenty-four hours, slicking hard on flesh and lightly on the grain, then tacking out to dry. When dry the leather is seasoned and finished. Coloring in a drum is the preferred method as it is easier to get uniform coloring than when the dye is applied by hand. If plain russet leather is wanted, the leather is taken after rinsing from the sumac bath and finished without coloring.

Finishing.—After the sides are dry, stake them and give the grain a coat of cornmeal filling. This is made by boiling slowly for thirty minutes one quart of dry cornmeal in a gallon of water. Allow the paste to cool, then strain it and give the leather a good coat, rubbing it in hard. When it is struck in well, roll the leather and hang it up to dry. It is then ready for the seasoning.

The following receipt makes a good waterproof finish for colored bag and case leather: Put a gallon of formaldehyde into a jug, and dissolve in it three pounds of casein. Keep the jug tightly corked. Then dissolve one pound of dextrine in a gallon of water and add one pint of vinette; stir well. Boil two ounces of cornstarch in two quarts of water and stir it into the dextrine-vinette mixture. Take one-half pint of the dissolved casein and add it to finish; strain the mixture well and then apply it to the leather.

Another receipt for a finish is as follows: Boil in one gallon of water, stirring until dissolved, one-half ounce 4F ammonia, two ounces O shellac and two ounces casein. Allow the solution to become cold; then add one gallon of water and one-half ounce of glycerine, mixing all together. Apply with a sponge evenly over the leather, then dry it. When dry, the leather is glossed on the machine, then grained and embossed or printed.

Equal parts of frozen glue, Irish moss and flaxseed also make a good finish.

For colored and russet leather the following finish is also recommended: Dissolve four ounces of blood albumen in one

gallon of water over night. Cook four ounces of granulated gelatine in one gallon of water and let it cool. Mix half a pint of white varnish shellac with half a pint of ammonia. Mix these three materials together and add enough water to make three gallons. Let this finish stand a week before using it. Apply with a sponge. For bright finish, dry and glaze. For dull finish, give two coats and roll while wet; then hang up to dry, and when dry give another coat. Finish by graining, printing or embossing.

The following seasoning gives a nice black luster that is lasting: Add eight ounces of logwood extract, one ounce of bichromate of potash and two ounces of prussiate of potash to two gallons of water and boil until dissolved. When cool, strain. To each gallon of the above add two quarts of beef blood or of blood albumen. Give one even coat and let it dry; then print, emboss and grain to get the desired figure, or finish smooth as may be desired.

FINISHING IMPERFECT GRAINS INTO PATENT TIPPING.

Among hides tanned for bag and case leather upon which a perfect grain is essential, there are found after the hides are split grains that are imperfect and therefore not suitable to be finished with the more perfect grains. Such grains can be made into patent tipping, upon which, the grain being buffed off, the imperfections will not be noticed.

The grains are taken from the splitting machine and washed in water at 90 degrees Fahr., to which one and one-half pounds of borax or washing soda to each fifty sides has been added, there being fifty gallons of water. In this water the grains are washed for one-half hour; they are then washed in clean cold water for fifteen minutes.

Retanning is done with fifteen gallons of one-bath chrome liquor, 25 degrees Baumé scale, dissolved in a barrel of water. The grains are run in a drum with this liquor for from one to two hours; then piled down over night. The next morning they should be washed for twenty minutes in running water.

Three quarts of extract of fustic are dissolved in one-half barrel of water and the leather is drummed in the solution one-half hour, after which it is fat-liquored.

Fifty sides may be fat-liquored with two pounds of neutral chip soap and nine pounds of the best moellon degreas in fifty gallons of water. The leather is run in this fat-liquor one-half hour and then placed in a pile over night. To prepare it for finishing it is set out and tacked on frames to dry. When the leather is dry it is buffed and staked; it is then in condition to be japanned and finished.

THE MANUFACTURE OF GOODYEAR WELTING.

The best welting is made from plump hides weighing fifty to sixty pounds and tanned expressly for welting. Welting is also made from the shoulders of belting butts, but such leather is harsh and brittle and not as satisfactory as that made from upper leather. The hides are soaked in the usual manner, thoroughly limed and bated down low to give a fine grain. The tanning should be done somewhat slowly and the tannage should be mild to prevent drawn and rough grain from too strong liquor. Any good upper leather tannage is suitable for welting. Hemlock and quebracho used in combination produce good leather. The proportions may be one part hemlock and two parts quebracho. The sides are suspended in weak coloring liquor for about twenty-four hours; then they are transferred to stronger liquor which is strengthened up from day to day until the sides are well struck through. Oak tan and oak and hemlock also make good welting leather. Leather tanned in weak liquors finishes softer and tougher than leather rushed through strong liquor. When the hides are well struck with the tan they are put in the press and made ready to be split. Before the leather is split, however, it is cropped and the bellies are sent back to be retanned. The backs are split six to eight ounces, according to the weight desired, and are then put into a drum and retanned in a strong gambier liquor. Palmetto extract may be used in place of gambier, but sumac

should not be used as it has a tendency to make the grain coarse.

The next process is bleaching to remove the stains from the splitting machine. The leather is run in the drum for thirty minutes in a solution of borax, using six pounds of borax to forty gallons of water at 100 degrees Fahr. After this the leather is washed in clear water to remove the borax; then it is milled in a solution of sulphuric acid, using one pint or more of the acid to forty gallons of water and running the leather in it for twenty minutes. The leather is then washed in clear water and fat-liquored.

Any good fat-liquor may be used, but the best results seem to be secured when neatsfoot oil and chip soap are used. The leather is drummed in warm water to warm it and then given the fat-liquor. It is next dried and sammied and set out very thoroughly. A light coat of cod oil cut with twenty-five per cent. of paraffine is then given to the grain; the leather is then turned over and struck out on the flesh, a light coat of fat-liquor being then applied to the flesh and the leather hung up to dry. When partly dried, the leather is taken down and re-set with a heavy slicker, then dried and put in press. The leather is neither rolled nor pressed and no finish is applied. If the work is carefully done, the grain has a light, clear color that readily absorbs any stain or color that may be applied. Rough leather of soft tannage makes good welting when finished in this manner but it must be firm and pliable and not harsh and brittle as so much welting is.

The shoulders of hides, the butts of which are made into belting, cut from the hides before they are tanned are largely used as welting. After the shoulders are tanned they are run through the splitting machine and leveled. They are then bleached with sulphuric acid after a borax bath as described, washed with clear water, scoured, hung up to dry and when they are in condition they are rolled on the sole leather roller. A coat of oil is then given to them and they are then dried out, receiving no other finish of any kind. This shoulder welt-

ing is never as good as that made from the backs of upper stock treated in the manner that has been described. Shoulder welting tanned with oak is preferred to other tannages.

HOW TO PREPARE HIDES FOR TANNING INTO LACE LEATHER.

Soak salted hides twenty-four hours, then put them into a wash-drum and wash them a half hour; then soak them twenty-four hours longer, flesh them and they are ready to be limed. Dry hides make good lace leather. Soak them in water containing some sulphide of sodium, say twelve ounces to each hundred gallons of water, for forty-eight hours, then put them in a mill and run them half an hour, then put them back into the old soak and soak them twenty-four hours longer. If the hides do not appear soft enough at the end of this time, place them in a pile over night and then either drum them again or put them in clean water for twenty-four hours. The hides, when sufficiently soft, are run through the fleshing machine and then started in the lime. In handling dry hides through the beamhouse it is safe to estimate their weight from green hides of the same size. Lime them about as long as for chrome shoe leather, using lime and red arsenic, which keep the hides flat, thus making long and tough fibers. Sulphide of sodium plumps the hides too much for lace leather.

After the hair has been removed, bate the hides with lactic acid. Warm sufficient water up to 90 degrees Fahr., put into it one quart of lactic acid and eight pounds of salt for every hundred pounds of hides. Run the hides in the paddle-vat one hour, then leave them in the liquor over night. The next morning run the paddle one hour, then take out the hides, wash them in warm water and then pickle them.

For each hundred pounds of hides use ten pounds of salt dissolved in fifteen gallons of water, adding one and one-half pounds of sulphuric acid, this liquor being put into a drum with the hides and the latter drummed in it one hour and a-half, then placed over horses to drain a few hours before tanning. Tan the hides in this manner: Weigh the pickled hides. For

every hundred pounds of hides dissolve two pounds of Glauber's salt and five pounds of common salt in twelve gallons of water. Drum the pickled hides in this solution thirty minutes, then drain the liquor out of the drum and throw in six pounds of salt and twelve gallons of water for each hundred pounds of skins and drum the hides fifteen minutes. Concentrated chrome liquor should then be poured into the drum and the tanning continued until the hides are tanned through. Twelve pounds of chrome material dissolved in three gallons of hot water, and the solution increased to twelve gallons by the addition of cold water, will tan one hundred pounds of hides.

Pour the liquor into the drum in portions of two gallons at a time at intervals of one-half hour, then drum the hides in it for six hours and let them lie in it over night, adding water to the liquor to make it sufficient to cover them well. In the morning run the drum three hours or longer until they are tanned through. Place the leather over horses to drain twenty-four hours, then wash it in warm borax water thirty minutes and in cold water one hour. The leather, tanned and washed, is next pressed and split. The splits can be finished into gussett splits, into glove leather or into lace leather. The split lace leather will be just as durable as the grain leather, but it will not look quite so nice.

If yellow lace leather is wanted, color it with extract of fustic and yellow dye before fat-liquoring it. If white leather is wanted, wash it in hot borax water, and then in water containing some sulphuric acid, then in clean water before fat-liquoring it.

The description that follows relates to a method of making leather especially suitable for belt, shoe and leather laces by the chrome process of tanning.

The hides are treated in the preparatory processes of un-hairing, bating, washing, etc., the same as any hides are treated for a chrome process. The first step in the making of the leather consists of drumming the hides in a drum, or paddling them in a vat in a solution of alum and salt. This is made up of two pounds of alum and four pounds of salt for each hun-

dred pounds of hides. In this liquor the hides are treated until they have absorbed it. The hides carry sufficient water as they come from the last washing to dissolve the alum and salt. After this treatment, the hides are allowed to press, drain and partly dry, when they are split and shaved. The tanning is then completed by drumming the hides in a one-bath chrome process, after which they are again washed and partially dried to get them in proper condition for fat-liquoring.

The fat-liquor is made as follows: Four ounces of common potash, or other alkali, are boiled in one-half gallon of water until dissolved; then two pounds of any good degreas and four pounds of tallow are added, and the whole brought to a quick boil. The compound requires to be thoroughly cooked. Then one-quarter gallon of neatsfoot oil is added, and the mixture stirred until the temperature reaches a little below boiling-point. The fat-liquor, while hot, is applied to the leather, the quantity named being used for one hundred pounds of leather, at a temperature of 150 degrees Fahr.

After the leather is fat-liquored, it is struck out and oiled off on the grain side with a light coat of neatsfoot oil, then stretched in frames until dry. After this it is moistened and staked and softened; and the staking and drying are continued until the leather is soft and dry. Then it is coated on both sides with a light coat of paste made with tallow, starch-flour, soap and water boiled together; then it is dried out again and finished in the usual way. As is the case when alum and salt are used before the chrome process is applied, the object of using them is to pickle the hides so that they will not draw or pucker when put into the tan liquor, and to preserve them so that they can be kept some time before they are chrome tanned, and also to enable the tanner to split them before tanning them.

An interesting feature of this process is in the fact that the salt and alum treatment permits the leather to be stuffed at a high temperature, thus insuring more thorough penetration of the stuffing grease, and the leather is made very elastic and durable and peculiarly suitable for lace leather.

Sulphate of alumina may be used in place of alum if preferred.

Lace leather made by a chrome process in this way does not harden, but remains strong, soft and pliable until it is worn out. The laces do not burn when they go over the pulleys. The splits taken from the hides can be tanned into glove leather, or they can be tanned same as the grains and sold for cheap lace leather. If colored leather is wanted, it can be dyed before it is fat-liquored.

Fat-liquoring is done in a warm drum; and all the ingredients should be thoroughly assimilated and taken up by the leather before it is dried out.

ANOTHER WAY TO TAN THE LEATHER.

Take the hides after they have been drenched and washed and put them into the drum with three pounds of sulphate of alumina and eight pounds of salt dissolved in ten gallons of water for every hundred pounds of hides. Run the drum an hour or longer, take the hides out, drain and press them for splitting. After the hides are split, weigh the grains and tan them in the following manner: For every hundred pounds of them, dissolve eight pounds of salt in fifteen gallons of water; run the grains in this solution one-half hour. Prepare the chrome liquor by dissolving twelve pounds of concentrated chrome material in ten gallons of hot water. Divide the solution into three portions. Add the first portion to the contents of the drum, run the hides in it for half an hour; then pour in the second portion and drum the hides half an hour; then add the rest of the liquor and run the drum five hours, at the end of which time the leather should be tanned. Add enough water to the contents of the drum to fully cover the leather and leave it in the same over night. After draining one day, the leather should be washed first in borax water and then in clear water, pressed and fat-liquored; or colored and fat-liquored if colored leather is wanted. From this point until the leather is done, the grains tanned as above directed are treated the same as the acid-pickled hides.

Fat-liquor for Lace Leather.—For each hundred pounds of leather washed and pressed use :

Moellon Degras	3 pounds.
Tallow	5 pounds.
Neatsfoot or Cod Oil.....	2 pounds.
Soda Ash	12 ounces.

Boil these ingredients in six gallons of water for forty minutes, more or less ; then run in cold water until there are twelve gallons of fat-liquor. Before using, stir into it six liquid ounces of strong ammonia. Use at 150 degrees Fahr. in a clean drum. Put the leather into the drum with fifteen gallons of boiling hot water and drum the leather in it ten minutes. This hot water warms the leather so that the grease will go in readily. Drain the water out of the drum, put on the door, start the drum and pour the fat liquor through the hollow axle. At the expiration of forty minutes, take the leather out of the drum and place it over horses for twenty-four hours ; then strike it out and oil the grain with neatsfoot or lard oil. Another good formula for fat-liquor is :

Soap	1 pound.
Neatsfoot Oil	3 pounds.
Tallow	3 pounds.
Carbonate of Potash	4 ounces.

These articles should be made into twelve gallons of fat-liquor for one hundred pounds of skins and used in the same manner as the preceding fat-liquor.

Oiling and Finishing.—Set the leather out hard and apply a liberal coat of warm neatsfoot oil to the grain ; then tack the leather on tacking frames to dry. Always stretch the leather lengthwise as the laces are cut that way. As soon as the leather is perfectly dry, take it from the frames, moisten it and stake it to soften it. Without any further treatment, the leather is now ready to be cut into laces and used ; but if a greasy grain is wanted, apply a paste to the leather after it has been staked. The paste is made of tallow, neatsfoot oil and flour. Take four parts of tallow and one part of neatsfoot oil, warm to 130 degrees Fahr. and mix thoroughly. Next take

two pounds of flour and stir it slowly into the oil and tallow and allow the mixture to get cold. Apply a liberal coat to the grain of the leather, rubbing it in with a stiff brush. Finally rub the grain hard with a glass slicker to make it smooth and glossy, dry the leather and it is finished. This greasy finish is not necessary, as excellent leather is made without it, but some people prefer lace leather with a greasy grain, and for such the finishing paste may be used. The splits taken from the tanned hides can be finished with the paste in the manner described, and will give good service as they are very tough and strong.

ALUM-TANNED LACE LEATHER.

The common wooden pail, capacity ten quarts, is used to measure the tanning ingredients. In a clean barrel place one pail of lump alum and two pails of salt. Dissolve the ingredients by the aid of steam and boil the solution three minutes, then pour it into the tan vat and plunge well. Dissolve one-fourth of a pail of carbonate of soda with hot water and pour it slowly into the vat, plunging the liquor briskly during the time it is being poured in. Effervescence takes place when the soda solution is mixed with the alum liquor and when it ceases the liquor, to be in right condition for use, should have a sweetish taste. If the liquor tastes sour add dissolved carbonate of soda and salt in the proportions stated until it tastes sweetish or neutral.

The liquor should be cold when the hides are placed in it. The liquor having been prepared, handle the pack from the fresh water and place it immediately in the liquor. Handle the hides fifteen minutes after they have been placed in the liquor, again at the expiration of half an hour and again at the end of the next half hour, then at intervals of two hours until the close of day. Frequent handling the first day the pack is in lays the foundation for an even tan and for a uniform grain, two important considerations.

The second day the pack is in the liquor, at uniform intervals of time, handle it four times; the third day handle it three

times, and the fourth day handle it twice; and near quitting time handle it up to drain over night, when it is ready for the finishing processes.

The pack being tanned and having drained over night, hang the sides up to sammy where there is not much current of air so that the more exposed parts will not dry before the less exposed parts are sammied enough. They must not be allowed to dry out completely in spots, and should this happen as it sometimes does, the sides with the dry spots should be taken down and the spots made wet; for in this tan, the longer the spots remain dry the harder it is to bring them back to the state of the surrounding parts. It is impossible to sammy them so evenly that no spots require to be dampened more or less.

Dry spots should have time to absorb sufficient moisture to become swollen before any grease is applied. Such being the case, dampen the sides where needed, fold and pack them closely in a box, and let them remain twenty-four hours, when they are ready to be stuffed.

After hanging up to sammy, the sides are in right condition to take town, dampen where needed, folded and placed in a box when they have dried out one-third.

The dubbing used to stuff the leather is made of pure tallow and neatsfoot oil in the following proportions, according to the time of the year: In summer time ten pounds of tallow and one pound of neatsfoot oil, and in winter time ten pounds of tallow and three pounds of neatsfoot oil. Of course the leather may be stuffed with tallow only, but the addition of some neatsfoot oil gives it a softer and mellower feel. Half a pound of resin to ten pounds of dubbing contributes to the preservation of the dubbing from oxidation. The dubbing is applied to the sides in a fluid state and at a temperature but little higher than that of the fusibility of the tallow.

Place the number of sides the stuffing-wheel will carry on a table, spread out one upon another. With a swab or suitable brush give each side a light coat of the fluid dubbing on both flesh and grain. Place the batch in the cold stuffing-wheel and

set the wheel in motion, and regulate the speed of the wheel so that the sides are carried nearly to the top of the wheel and then fall to the bottom, to be carried up again to fall. They should neither roll nor swing over, for when they do it is time and power wasted. It requires contact of the sides with the pins of the wheel to work the grease into the leather.

When the sides have absorbed the grease take them out of the wheel, hang them up until they get partially dried. Then with a stone having well-rounded corners go over the sides on the flesh side on a table and straighten them out, when they are ready for shaving. Shave them lightly and with an eye to levelness. Then coat both flesh and grain with melted dubbing. Place them again in the stuffing-wheel and let it run until they have absorbed all the grease. Hang the leather up and when it is nearly dry snuff it over with the currying knife on the flesh side, set the flesh out, stone, slick and glass the grain oil lightly on grain, hang up to dry out completely, then take down, glass on the flesh and brush on the grain, when the leather is ready for market.

The following is an old method of making lace leather: For every hundred pounds of hides ready to be tanned a tanning mixture is made of fifty gallons of water, ten pounds of alum, two and a-half pounds sal soda, three pounds of common salt and from two to three pounds of bran. These ingredients are made into a liquor, and the hides are treated with the same in a drum or vat, after which they are dried out. They are then split and a mixture of lard oil and tallow applied, after which they are again dried. The hides are then moistened and shaved and the entire grain is removed to prevent cracking and breaking. Finally rub into the hides a mixture of one and a-half pounds of lard oil, one-half pound of tallow, and a few ounces of flour for every ten pounds of hide; let them dry, then moisten, stake and stretch them, and the hides are ready for use.

Lace leather that is soft and strong is also made by beginning the tanning in an old weak bark, oak or gambier liquor, the hides being left in it only long enough to become uniformly

colored. The toughness of the leather is increased by supplementing a gambier tanning with alum and salt, coloring the hides with gambier and then giving them the alum and salt. Upon coming from the tanning liquor, the leather is hung up and dried. It may also be further tanned with oil and grease. Different processes of greasing are used. A good mixture consists of oil, flour, grease and salt. These are drummed into the hides in a drum, the leather then hung up and dried. Degras combined with oil and fat imparts great softness to the stock. After the leather becomes dry, the grain may be buffed. It may also be removed before the hides are tanned. Setting-out and working the leather complete the process.

Another tanning composition for lace and whip leather consists of twenty-five gallons of warm water, two pounds of alum, ten pounds of salt, one pound of sulphuric acid, two pounds of bran and two ounces of dissolved sulphur or the same quantity of gambier. The hides are left in this liquor one hour, then one ounce of sulphuric acid, four pounds of salt and two ounces of alum are dissolved and added to the liquor. In this combined liquor the hides are tanned, then hung up and dried. For lace leather the hides are given a mixture of one pound of fish oil, one pound of tallow, four ounces of linseed oil and two ounces of soda soap dissolved in a gallon of hot water. The hides are then dried again and worked soft.

Alum-tanned hides, dried and moistened, can be stuffed with tallow, degreas and cod oil. The weight of a lot of hides is obtained by weighing them dry and deducting one-third from the weight of the sammied hides. For one hundred pounds of dry leather use ten pounds of tallow, ten pounds of degreas and ten pounds of cod oil, melted together and put into the wheel at 90 degrees Fahr. Considerable drumming is necessary to get the grease into the hides. The hides are then dried and softened. They are next glassed out, smoothly shaved on the flesh and the grain removed by buffing to prevent the laces from cracking. The leather is then rubbed with a mixture of lard, oil, tallow and flour, and then finished by being laid out flat upon a table and smoothed out with a glass slicker.

To obtain the yellow color sometimes desired pulverized sulphur may be added to the tanning liquor; and for a darker shade gambier may be used.

Rawhide lace leather is made by sweating the hides until the hair is removed, then drying them and working them by stretching and beating until they are thoroughly softened and in condition to be used.

Raw Hide Lace Leather.—This variety is tanned with alum and salt and great strength and pliability are obtained. The hides are soaked and softened in the usual manner, then placed in the lime. In this they are left only long enough to remove the hair, as longer liming makes the leather too loose. In place of lime, sulphide of sodium may be used to remove the hair and in this case the hides are also limed lightly. After the hair is removed, the hides are cleaned with lactic acid and are then ready to be tanned.

A tanning liquor is made up of fifteen pounds of alum and thirty pounds of salt in sufficient water to cover fifty sides. The sides are left in this liquor twenty-four hours. Then the liquor is run off and the sides are given twenty-five pounds of alum and fifty pounds of salt and handled twice each day. The sides should remain in the liquor two days, then be hung up to dry. When dry, they are dampened down for two or three days and then worked out on the staker. To grease the sides fifty pounds of white tallow and two quarts of pine tar are mixed and applied hot to both sides of the leather. The sides are then put into the drum, heated with steam to 85 degrees Fahr., and run one hour and fifteen minutes, more or less. The leather is then staked on the flesh side, restuffed same as before and then set out lengthwise of the flesh and grain, and then hung up to dry by neck and tail. The tanning can also be done in a drum.

A process that is a little different from the preceding one is carried out as follows: After they are tanned with alum and salt, the sides are hung up to dry. They are not allowed to dry completely, but are staked while a little damp and then

are dried completely. The dry leather is then stuffed. In a warm room the leather is dried and made warm and then given a coat of hot tallow. The tallow should penetrate through and through until the hides will absorb no more. The leather can then be run in a dry drum; stretched, the superfluous grease rubbed off when it is ready for use.

OTHER METHODS OF MAKING LACE LEATHER.

Some tanners make lace leather by using gambier, alum and salt. The bated and washed hides are suspended in gambier liquor for a few days and then are put into a solution of salt and alum. This process produces a thick grain that presents an excellent surface to the buffs. When taken from the salt and alum solution, the hides are dried, then wet down and left to sammy. As soon as they are soft and moist they are stuffed with a mixture of hard grease, degreas and cod oil. The leather is then shaved, buffed, and finally set out first by machine and then by hand.

Tawed lace leather is made by drumming the sides in a solution of sulphate of alumina, sulphate of potash, sulphate of soda and neatsfoot oil. The solution is heated to 95 degrees Fahr., and the sides are drummed in it for about an hour, after which they are removed from the drum and left to drain for three or four hours. The tanning is then repeated. After the second milling in the tanning solution the sides are hung up to dry. When dry, they are dampened, staked, shaved, slicked, stuffed with tallow and neatsfoot oil, and then finally dried.

Tawing may also be done by means of a solution of one-half pound of salt, one-half pound of soda and two pounds of alum in ten gallons of water, to which one-half pound of bran is added. This quantity is calculated for twenty pounds of raw hide. In this solution the hides are drummed, then they are dried and dampened. Stuffing with a mixture of three parts oil and one part tallow is the next process; it is done in the usual way.

A water bath to which bran has been added is given next,

and immediately after the leather is taken from the bath it is worked out well on the flesh side and then given the second stuffing. For the second stuffing equal parts of oil and tallow and a little flour are used. By the latter softness and pliability are obtained.

PICKER LEATHER.

Picker leather is used very extensively in cotton, woolen and silk mills. Great care must be taken in the manufacture of this leather. It must be soft and mellow so that it can be tied into knots, etc.; and above all, it should be tough in every way so that it will not tear or rip out where loops are cut into it to fasten on to the shuttle. The hides must be of good steer selection, say from fifty to sixty pounds, then soaked in the usual way, with plenty of cold, fresh water.

Liming.—When thoroughly soaked the hides are taken to the limes and limed as follows: To every fifty sides use one bushel of lime; slack and reduce the lime to liquid form with water and run the same into the lime vats with sufficient water to cover the stock and reel the sides from vat to vat. This reeling must be repeated at least five times during the first ten hours the sides are subjected to the liming process. When sufficiently limed, that is to say, when the short hair can be worked out, the sides are reeled into warm water, 100 degrees Fahr. This heat must be maintained, and the stock should again be reeled at the expiration of twenty-four hours; after remaining in this warm bath forty-eight hours, the hides are ready for the beam. The stock being now ready for unhairing, the hides can be unhaired by any of the well-known machines, or this work can be done on a beam by hand. Usually hides unhaired by machine must be gone over again on the beam when worked out of bate. Tanners differ in regard to this last working. The sides being unhaired are now ready for fleshing. When the hides have been unhaired and fleshed they should be bated down until they are soft and silky. Liming with lime and red arsenic as for lace leather is a good way to lime the hides.

Bating.—Lactic acid either in its commercial form or as used for chrome leather in conjunction with sour glucose is a satisfactory bate for this class of leather. All the lime should be removed, and the hides should be soft, low and clean before they are put into the tan liquor.

Tanning.—Gambier is preferable as a tanning agent, as it is a quick and soft tannage. The leather has that mellow feeling that all good picker leather must have. Oak tannage also produces soft, tough leather. The oak process is as follows: The coloring must be done in vats, with a reel attached, or rather constructed between the two vats, and the sides may be fastened together with S hooks; in fact they can be tanned entirely in reel vats if the proper attention is given to them. They must be reeled regularly, and the liquor must be gradually strengthened until the stock is thoroughly tanned.

Lactic acid used in the first stages of coloring proves advantageous. By proper use of lactic acid quick results may be obtained and plump yet mellow leather. This method is known as the oak-bark tannage, and it is well to add that when the hides are put into the liquor fresh from the beamhouse the liquor should not be over 2 degrees barkometer, and lactic acid is best employed for plumping after the third day the stock is in the liquor.

Gambier-picker leather is treated in the same manner as oak-picker leather in the first stages of tanning or until the grain and flesh are nicely struck through with tannin. They are then ready for a special treatment, which forms the yellow streak in the center of the hide.

The gambier liquor is made from gambier, alum and salt, about four per cent. alum and one per cent. salt and sufficient gambier to make the liquor show a bright orange color. This bath must be heated to 90 degrees Fahr. At the end of one hour draw the sides out and return them to the liquor and in two hours repeat again, and again in three hours. The following day raise and put back again. Now let the stock remain for twenty-four hours, then hang it up and sammy quickly.

Stuffing.—Put the sides into a stuffing wheel with all the tallow they will take, say from five to six pounds, until all sign of the tallow has gone into the stock. The sides should now be set on machine, then reset by hand and given a good coat of dubbin made of tallow and sperm oil. About sixty per cent. sperm oil is used to forty per cent. tallow. The tallow must be allowed to stand until cool enough so that the hand can be borne in it without pain or until a slight skim arises on the surface of the tallow. The sperm oil can now be added, the tallow being constantly stirred while the oil is poured in slowly. This will make a fine, close dubbin and both oil and tallow will penetrate. Should the oil be added when the tallow is hot, it will result in what curriers call “fish eggs,” and only the oil will penetrate the stock, which is very undesirable.

TANNING AND FINISHING SPLITS.

The splits that are taken from untanned hides, that is, from hides that are split out of the lime or out of acid pickle or out of a pickle of sulphate of alumina and salt can be tanned with extract of hemlock, quebracho, gambier, etc., and finished into innersoling and other leather; they may also be tanned in a chrome process and made into glove leather. Splits taken from limed hides are drenched with lactic acid or some other suitable material, then tacked on sticks and suspended in the tan liquor and tanned wholly by suspension. Splits taken from hides full of acid and salt should be first milled in a solution of ten pounds of salt and four gallons of water for one hundred pounds of splits, for twenty minutes. This puts all parts of the splits into condition to take the tan liquor. The first liquor into which the splits are placed is a plumping liquor made of hemlock extract and should contain at least ten per cent. of lactic acid to swell the fibers of the splits so that they can take up the tannin. The splits should then be put into a regular bark yard and worked through stronger liquors, being handled every other day. From two to three weeks are required to tan the splits, depending upon their thickness.

Splits taken from hides pickled with sulphate of alumina and salt may be put into weak liquor or drummed therein and then tanned in gradually increasing strengths of hemlock liquor until they are fully tanned. No salt is needed in the liquors, and the alumina or alum becomes washed out before the tanning is finished.

The best way to tan splits is by suspending them in the liquor. Where this cannot be done because of lack of vats, a paddle vat may be used; this is better than a drum. In the paddle vat there is no violent pounding, and the splits therefore finish up finer than when a drum is used. Heavy splits may be put into a ten-degree barkometer quermos extract in a paddle vat until struck through. They should then be tanned in strong hemlock bark or hemlock extract liquor until thoroughly filled and tanned. For light, flexible splits some softer tannage may be used, such as quermos extract, the first liquor being 10 degrees barkometer, and the splits then passed into stronger liquor or the weak liquor may be strengthened. This method of tanning makes soft splits that require very little oil or fat-liquor.

Before splits full of alum or sulphate of alumina and salt are put into extract or bark liquors, they should be preferably drummed in a weak gambier or palmetto liquor until they are softened. They should then be tanned in strong liquors, the alum and salt disappearing before the splits are ready to be finished. The splits should never be washed in water before they are tanned or they will be flat and flabby when finished.

Splits are improved by being drummed in a gambier liquor after they are tanned. This has no effect as a tannage, but gives a softer texture to the leather. Scouring and cleaning the leather of all dirt and foreign material is also beneficial, or the splits can be taken after they are fully tanned and drained and then rinsed in a vat of water, which will remove any sediment on them. They should never be put into a drum and washed, for this causes them to lose their plumpness and to fall away and become thin. After they are rinsed off they are

hung on poles to dry. The dry splits are dampened and stuffed.

Rough splits for innersoling are retanned with a mixture of two-thirds quebracho extract and one-third hemlock extract, then rinsed and retanned with sumac in a vat. They are then partly dried and stuffed. A good stuffing mixture is made of one part tallow, two parts soap, six parts Irish moss and thirty parts water. After the splits have been stuffed they are set out on a table and a mixture of six parts Irish moss, one part starch and two parts soap is rubbed in on both flesh and grain sides with a stiff brush. They are then set out with a slicker and hung up flat to dry. A jacking completes the work. Tanners who want to increase the weight of their splits add a little grape sugar to the stuffing mixture.

Splits taken from hides tanned with hemlock, quebracho and chestnut extract in combination process can be worked into Goodyear by being trimmed after they are split and retanned in a paddle-wheel with a combination liquor composed of quebracho and chestnut extract. They should be run in a mill with a weak liquor for one-half hour to break up the crust caused by the belt-knife. They are then put into a 16-degree liquor and left in the same forty-eight hours, then placed in piles forty-eight hours, and then returned to the liquor for forty-eight hours, the paddle being run about two hours in the morning and two hours in the afternoon. When they are well filled they are left in piles a few hours, then put into a drum with the following mixture: For fifty Goodyears use four pounds of flour, eight pounds of epsom salts, one gallon of cod oil, one gallon of moellon degreas and ten pounds of talc, all mixed together into a smooth paste; then add water at 85 degrees Fahr. to make twenty-five gallons. Run the splits in this solution one-half hour and put them in piles over night. In the morning set them out very thoroughly, apply a paste made of Irish moss and flour, and hang them up to dry. When dry give a coat of Irish moss and talc on both sides and roll hard; then dry.

Softening and Stuffing Heavy Splits.—The dry splits require

very careful dampening and softening. A good way to do this is to wet one-half of them in water. Then place a dry split on the floor, then a wet split on top of it, then another dry one and then another wet one until all are piled down. Let them lay two, three or four days to become uniformly soft and damp, keeping them well covered during that time. Proper dampening is the secret of soft, well-filled splits. The splits can also be dampened by being sprinkled with water or sprayed with a hose-spray and left in covered piles until they are damp and soft. Two hundred pounds of dry splits should not weigh more than two hundred and sixty pounds when dampened.

The amount of grease and the kind of grease to be used must be decided by the operator and depends upon the tannage. Some tannages will take more stuffing than others. Gambier and other soft tannages do not require as much grease as hemlock and combination tannages. The harder the grease the more can be put in. Sometimes one hundred pounds of dry splits will carry over one hundred pounds of grease, one hundred and ten pounds being the maximum.

The grease should be heated to 140 degrees Fahr., and the drum should be heated with live steam to the same temperature before the splits are put in. Some degreas may be used and a little sod oil, say ten per cent. of the latter, but not more and this only when the grease is very good and hard, or when stearine is used in making the stuffing. The splits should be carefully weighed, likewise the grease, the splits then carefully and uniformly dampened, and the right temperature maintained during the process. A good stuffing mixture for gambier-tanned splits is made as follows: Six gallons of brown grease, four gallons of common degreas and two gallons of stearine. If the brown grease is good use less stearine. Use from one to one and a half gallons of sod oil to every twelve gallons of the mixture described. If the splits are very hard use a half gallon more of sod oil to each twelve gallons of stuffing. The amount of grease to be used depends upon the tannage. After the splits have been stuffed they are finished by being whitened,

blackened with soap and lampblack blacking, dried, trimmed, given a paste of flour, dried, rolled or glazed and covered with a size made of gum tragacanth, dried again, sorted and graded.

Stuffing for Wax Splits.—To make one hundred pounds of stuffing grease, take forty-five pounds of tallow, ten pounds of degreas, twenty-five pounds of stearine, twenty pounds of paraffin wax. Dissolve the stearine and wax, add the tallow and then the degreas. Use from thirty-five to forty pounds of the stuffing to one hundred pounds of dampened splits. Heat the wheel to 135 degrees Fahr. and the grease to the same temperature. Let the wheel run for twenty minutes with the door closed and for ten minutes with the door open. Hang the splits until they are well cooled off and good and stiff; then set them out tightly on the back and then on the face side, and hang them up to dry.

Another receipt for stuffing is: In a suitable kettle cook hard glucose to 140 degrees Fahr. In another kettle place one-half degreas, one-half brown grease and one-third best stearine, and cook thoroughly. Use about twelve pounds of glucose with forty pounds of combination grease, mixing just before using. The glucose will give a good color and weight, but it must be used carefully and with judgment. If the splits are too wet or too dry or of hard tannage no stearine is necessary. Under such conditions good brown grease and degreas and glucose will be enough. Dampening for stuffing should be done in such manner that three hundred pounds of splits take an additional weight of thirty-five pounds.

Finish for the Back.—When splits are dry, after stuffing and setting out, pack them down in a pile for a few days; then whiten them lightly on the back and to a fine face on the side to be finished. Now trim the edges and place the stock on a table flesh side up for the back finish. Make a paste for the back finish by mixing together two pounds each of red lead and yellow ochre and pour in slowly one gallon of cold water, stir while pouring. Dissolve one pound of corn starch in one gallon of cold water. Boil the lead and ochre and pour in the

starch; stir well and boil until cooked. Then let the finish cool and it is ready for use. Spread an even coat on the flesh with a soft brush. Hang the stock up to dry and then glass with a jack. If the paste is too thick add more water, and if it is not the desired color change the quantities of lead and ochre to suit.

Soap Black.—To make a soap black, dissolve twelve pounds of common soap in half a common oil barrel full of water, with two pounds of common potash. Add from twelve to fifteen pounds of lampblack, according to quality. Boil slowly after the black has been mixed in. Then add two pails of strong logwood liquor and one pound of indigo or Prussian blue and boil and stir thoroughly; then fill the barrel with cold water and add one pint of muriate of iron. Spread this black with one brush and rub it in with another brush. Sweep any smut off with a table duster. If the glassing is to be done by hand, glass right after blacking. If the stock is glassed with a jack, hang the splits up after blacking before glassing. When the black dries they are ready to be jack-glassed.

Flour Paste.—For pasting make a stiff flour paste by mixing four quarts of flour in two gallons of cold water. Put in a little water at a time and stir well to keep lumps from forming. When thoroughly mixed, boil for ten minutes with live steam, then add one-half pound of tallow and one-half pound of common soap. Boil until thoroughly cooked. Let the paste cool and spread on a fairly heavy coat evenly with a fine sponge. Hang up the splits, and after the paste is dry, glass either with jack or by hand. If the splits will stand it they can be oiled over the most solid parts on the black side. Good judgment must be used in oiling so as not to have the stock show the oil after it is finished, as heavy mill-stuffed leather will not stand much oil in finishing.

For finishing give an even coat of gum tragacanth dissolved to a thin substance. When dry the splits are ready to be sorted.

FINISHING SPLITS INTO GOODYEARS, CHAIR SPLITS, ETC.

The splits are taken from the splitting machine and trimmed, then put into a mill with a weak tanning liquor of 6 to 8 degrees, and milled for one hour. This milling will break up the crust made by the belt knife and open up the split so that it will take the re-tan liquor. After they are milled, they can be re-tanned in a mill or put back into the tan yard for three weeks in a strong liquor. The splits should be pulled out of the liquor every other day and allowed to drain about four to six hours, the liquor strengthened up and the splits put back one at a time. If the tanning is done in a mill it will take about six days to make a good split. The splits should be milled in a strong liquor about two hours each day and then left in piles the remainder of the day. This operation is repeated daily for six days when the splits will be full-tanned.

After the splits are tanned they are sorted and the heavy splits can be worked into flexibles or Goodyears, while the light ones can be worked into chair seats.

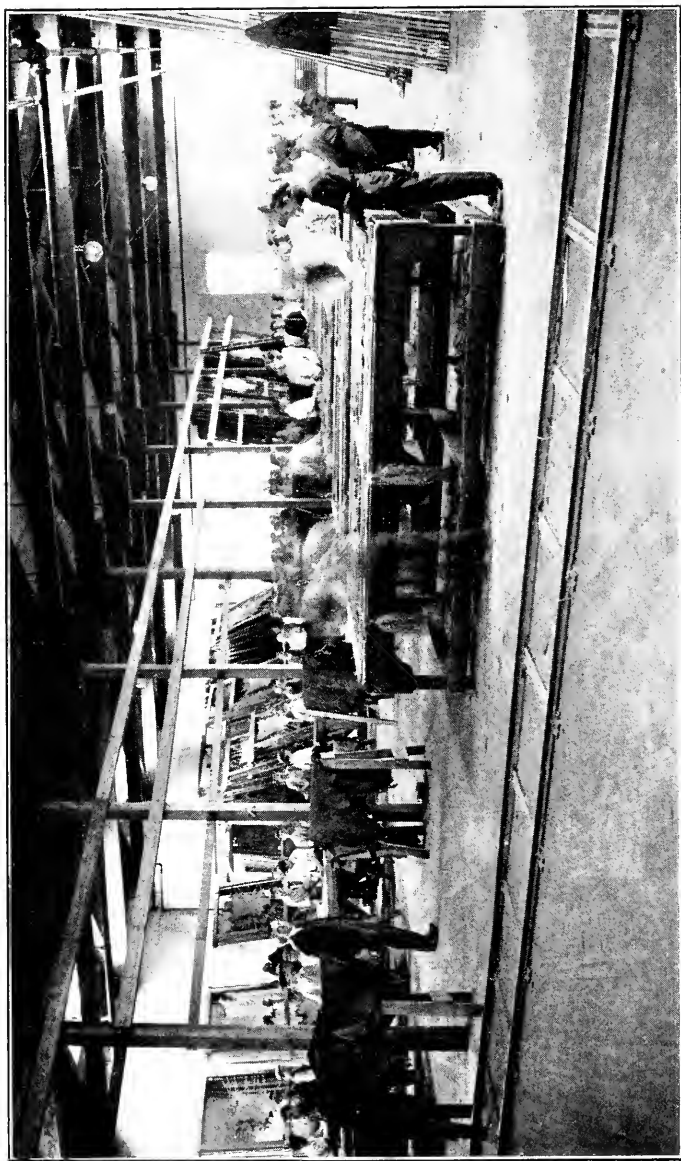
If flexibles are to be made they are put into the mill (after lying 48 hours after the last tanning) and given a milling in a strong solution of epsom salt. This will give them a light color without removing any of the tan. The epsom salt solution is made by dissolving seventy-five pounds of epsom salts in fifty gallons of water. Use about twelve gallons of the solution to every eight splits. Mill them in it thirty minutes, then pile them down over night. The next day set out and hang up to dry. When the splits are dry dip them in warm water and lay in piles 24 hours, then give them a coat of Irish moss and soap and roll hard and hang up to dry. When dry, trim and measure. If Goodyear splits are to be made the splits are to be trimmed so as to have the proper bend for Goodyears. The trimmings are finished in the same manner as the flexibles and sold for cheap insoles, then the bend is leveled up on the splitting machine. Bends for Goodyears must be of uniform substance. After they are leveled they are fat-liquored with soap and cod oil, using one-half pound of soap and three

pounds of oil to each one hundred pounds of leather. Run in the fat-liquor and pile down over night. Now make up a clearing liquor of sixteen gallons of water and two pounds of lactic acid. Run the bends in this ten minutes and take out and hang up to dry, taking pains to have them dry flat.

When they are dry make up a paste of three pounds of frozen glue, one pound of white soap, one pound of Irish moss and one quart of finishing oil. Soak the glue over night in three gallons of water. In the morning add the soap and moss and oil and boil for an hour, then add enough water to make ten gallons and strain. When cold, give the splits a good heavy coat and hang them up until it is struck in. Then roll hard and treat the other side the same way. When they are dry they are finished.

If the light splits are to be put into chair splits they are leveled on the machine, then put in a mill and given a milling in a sumac liquor, using one pail of sumac in twelve gallons of water for each dozen splits. Mill the splits for one hour, then pile them down 24 hours and set out on both sides and hang up to dry. Do not hang over sticks. Trim off all the shanks and thin edges. When they are dry, make up a filling paste of one-half pound of corn starch, one-half pound of dextrine, one pound of casein that has been soaked over night in three gallons of water, and boil this mixture slowly for an hour. While it is boiling add one-half pound of ivory soap cut up in fine shavings. This will make ten gallons of paste. Aniline dye of any color desired can be added to the paste and the splits made into any color. The splits should be given a good coat of this paste. It should be put on smooth and when about half dry, the splits should be rolled hard and dried, and they are then in condition to be embossed.

After embossing, the splits are given a coat of waterproof finish made by cutting up shellac or casein and adding aniline that is made to dissolve in spirits to the finish; by using aniline the same color as the splits it will give the finished split a much richer color. These splits are often worked into cheap suit cases and bags.



STRETCHING LEATHER IN FRAMES BEFORE FINISHING IT.

SECTION TWO.

THE MANUFACTURE OF SHEEPSKIN LEATHER.

THE first process to which sheep pelts are subjected by the wool-puller and tanner is soaking. By means of this process, which consists of immersing the pelts in water, the skins are softened and adhering dirt and salt are dissolved and removed from them.

Green salted skins require only a few hours soaking, while heavily salted skins and those received in dry condition require longer soaking and more thorough softening. In warm weather green salted skins soak sufficiently in ten hours, and in cold weather they may be soaked from ten to twenty hours without injury. No exact rule needs to be followed. When the skins are soft and the salt dissolved, the pelts have been soaked enough. Clean fresh water should be used. As soon as the pelts are sufficiently soaked, they should be removed from the water and thrown over horses and allowed to drain for several hours, or they may be passed through an extractor by means of which the surplus water is taken out of them. It is a matter of importance that the salty and dirty water be gotten rid of before any depilatory is applied to the skins as an imperfect and cloudy grain results when this is not done. Clean water should be used, as foul water starts the wool and injures the grain. Ten pounds of borax dissolved and added to the water before the skins are put in helps to soften the skins and remove the dirt. Dry skins should be soaked in such a soak until they are quite pliable, then run in a drum or otherwise broken and then soaked a few hours longer, drained and depilated.

METHODS OF REMOVING THE WOOL.

To accomplish the removal of the wool, sulphide of sodium

and lime are generally used. Three formulas are given as follows:

1. Put twenty-five pounds of lime into a tub and add just enough hot water to cover it. In another tub or barrel dissolve twenty-five pounds of sulphide of sodium in ten gallons of hot water. Stir the lime until it is entirely slaked and the sulphide of sodium until it is dissolved, then mix the lime and sulphide solutions together and apply the mixture cold to the flesh side of the skins, folding each skin flesh side in. Lay the skins in a cool, moist place for twenty-four hours when the wool can easily be removed. The painting of the skins should always be done in a moist room, and the edges of the skins must be kept from drying or the wool will pull hard and lime blasts will show on the skins later. During the winter the skins must be kept from freezing.

The pelts are spread upon a table and the mixture of lime and sulphide of sodium applied to the flesh side. Only enough liquor should be used to saturate the skins and none allowed to run off onto the wool. The workman must wear rubber gloves to prevent his hands from getting sore.

After the skins have been painted, fold them lengthwise, wool out, and place them in numerous piles. When the weather is cold six or seven skins may be put together in a pile, but in warm weather not more than three or four should be so placed, and if they are to lie twenty-four hours or longer they should be singled out and each pelt lie by itself. The wool becomes loosened in a few hours, but should not be removed until the next day when it will come off easily and cleanly. Very young lamb skins should have the wool removed as soon as it starts, and then be put into clean cold water, containing some sulphide of sodium in which they may be kept until they are free from dirt and fine hairs.

2. A good depilatory liquor is made by dissolving sulphide of sodium in water until the solution stands at eighteen to twenty degrees Baumé test, and adding eighteen gallons of slaked lime. Apply this to the skins when it is cold.

3. Place a bushel of lime in the center of a tub and add to it one and a-half pounds of sulphide of sodium, mixing the two well together. Pour hot water upon the lime and sulphide and stir until both are dissolved. Add water until the mixture has the consistency of paste and let it cool before using it. The table upon which the pelts are painted should be kept clean and free from the sulphide paste or it will damage the wool and cause loss.

LIMING AFTER REMOVAL OF THE WOOL.

To start the liming of the skins slake two gallons of lime with six gallons of water. This is enough for one hundred average size skins. Pour the lime into water in the vat, put the skins in and leave them in one day, then haul them out and add one gallon of lime slaked with five gallons of water and put the skins in for another day, then haul them out and put in a little more lime and leave the skins in for a day or two longer.

After the wool has been removed from the skins it is good practice to wash them in a solution of bicarbonate of soda. Use one pound to the dozen skins in water at 80 degrees Fahr. and wash the skins in this solution in a drum for an hour, then wash them in clear water for another hour and the skins will be found free from sulphide and in good condition to be limed. Next give the skins weak lime for a few days, wash them and then drench them in a lactic acid drench.

THE SULPHIDE OF SODIUM PROCESS.

What is known as the sulphide process is carried out in the following manner: Prepare a solution of sulphide of sodium by dissolving one and one-fourth pounds in three or four gallons of hot water for each dozen skins to be treated. When the solution is cold it is ready for use. Take the skins as they come from the puller, put them into a revolving drum and add the sulphide liquor. Close the drum and run it for two hours, then let it remain stationary for ten hours or until the next morning. Then take the skins out of the sulphide liquor, wash

and drench them the same as limed skins. If the skins are to be made into soft leather, as for gloves and linings, they should be washed in water containing one pound of bicarbonate of soda for each dozen skins and then in clear water to remove the sulphide, then limed a few days, washed again, drenched and pickled. If firm leather is wanted the liming can be omitted, the skins being treated with sulphide of sodium as described, then washed in warm water containing one pound of bicarbonate of soda for each dozen skins. Wash the skins in this liquor one hour and then drench them with lactic acid or sour bran. Trimming and fleshing are done after the skins have been taken out of the sulphide liquor and washed in warm water. This method of handling the skins makes tougher and plumper and firmer leather than liming in the old-fashioned way.

METHODS OF DRENCHING SHEEPSKINS.

Prepare a paddle wheel with water and heat it to 120 degrees Fahr. Put into the warm water two pails full of dry bran and let it stand over night. The next morning bring the temperature up to 95 degrees, and take one pint of lactic acid for every one hundred pounds of skins and put about half of it into the bran liquor, then throw in the skins, and add the rest of the acid slowly afterwards. Run the paddle wheel for from two to four hours according to the thickness of the skins and the amount of lime in them, then take the skins out and wash them with warm water. This washing should not be neglected, especially if the tanned skins are to be colored. After the skins have been washed they are ready to be pickled.

For the second pack of skins run the drench liquor down about twelve inches and run in an equal quantity of water. Heat the liquor to 95 degrees Fahr. Do not use any more bran but take one pint of lactic acid for every hundred pounds of skins to be treated, and proceed exactly as described for the first lot of skins. Continue in this way for six days, then run off all the liquor and make up a fresh liquor with water at 120 de-

grees Fahr., and two pails of dry bran, allow same to stand at least twelve hours and then proceed in the manner described. This method of drenching makes the skins soft and clean and in good condition for chrome, alum or vegetable tanning.

Another Method.—For an average weight lot of eight hundred to one thousand sheepskins, twenty pounds of lactic acid and twenty pounds of common salt are required. The water should be about 85 degrees Fahr.; if cooler than this more salt will be required to keep down the plumpness. Half of the acid and all of the salt should be added to the water before the skins are put in; after the skins have been in fifteen minutes the rest of the acid should be put in. The time for drenching should be about forty-five minutes in a paddle vat; in a still vat two to three hours, the skins being stirred three or four times during that time. Several lots of skins may be put through this drench, with a fresh addition of fifteen pounds lactic acid for each succeeding pack, adding five pounds at first and ten pounds after the skins have been in fifteen minutes. After the skins have been drenched they should be rinsed in warm water and then pickled.

The skins can be nicely drenched by using one pint of lactic acid for every hundred pounds of skins; and by careful and thorough washing before drenching the quantity of acid can be reduced to one and a half pints for every two hundred pounds of skins.

Drenching with Bran.—Take a half-barrel of bran, add enough water to make it mushy, cover it up and let it stand for forty-eight hours to sour. Into a vat of water large enough to hold four hundred skins that is half filled with water, empty the sour bran. Add about one and a half quarts of sulphuric acid and three pecks of common salt, mix thoroughly and heat to 90 degrees Fahr. Throw the pack of skins into the prepared drench and keep the paddle turning for three hours, heavy skins being treated a half hour longer. The skins will be made soft and clean by this treatment, and will require no working on the beam if intended for black leather, but for colored skins it is

advisable to work them out on the beam so that the grain will be clear. After the skins have been drenched, they should be washed in warm water, whether they are intended to be worked over or not, and they will then be in splendid condition to be pickled and tanned. Another formula for a bran drench is as follows: Take fifty pounds of bran, add water to make a mush, and let it stand until it is sour, then put the sour bran into a paddle-wheel with seven hundred gallons of warm water. Add ten pounds of sulphuric acid and paddle the skins until they are soft and clean. Rinse them in warm water and work them over the beam and then pickle them.

Pickling with Sulphuric Acid and Salt.—Pickling may be done in a paddle-vat or in a drum. Fill a paddle-vat with clean, cold water until the water touches the paddles. For every one hundred gallons of water in the vat put in thirty-five pounds of clean salt. The washed skins should have been draining a few hours before they are pickled. Then for every hundred pounds of skins put into the salt water in the vat one and a half pounds of sulphuric acid and ten pounds of salt. Plunge up the pickle liquor and put the skins into it. Run the paddle for an hour and a half and then let the skins lie in the liquor an hour or two; then place them over horses to press and drain twenty-four hours before pressing and tanning them. Pickling bleaches the skins, keeps them from spoiling and helps to make the leather of uniform quality. The skins can also be pickled in this manner: Use three quarts of sulphuric acid and seventy-five pounds of salt for one hundred average skins, with water enough to cover them. Add the salt to the water, then the acid, plunge up thoroughly, put the skins in, and let them remain in the pickle from two to three hours. Before the skins are pressed and tanned they should drain out of the pickle for at least a few hours, and it is better if they can press and drain several days before they are tanned. To pickle the skins in a drum, weigh them and prepare a pickling liquor in a tub or barrel by adding one pound of sulphuric acid and fifteen pounds of salt to fifteen gallons of water for each one hundred

pounds of skins. Run the skins in this liquor from thirty minutes to one hour; then horse them up smoothly for at least twenty-four hours before tanning them. One pound of acid is the maximum quantity that should be used. A little less than one pound will be found sufficient for light, thin skins. When the skins are to be sold in pickled condition, they are allowed to drain, and are then sorted according to size and quality and rolled up in bundles of one dozen each. To get the best results, a tanner should do his own wool-pulling and skin-pickling, since he can get more uniform results than he can get by buying pickled skins from various dealers and wool-pullers, no two of whom treat the skins exactly alike.

PRESSING THE GREASE FROM PICKLED SHEEPSKINS.

The following method of removing grease from pickled sheepskins by hydraulic pressure is the most satisfactory one that can be used:

Get a sufficient number of sheet-iron plates as large as the press will take, about one-sixteenth of an inch thick; place one dozen of skins on each plate, spread out flat with the bellies and shanks folded in, so as to have each plate of skins about the same size. Place the butt of one skin over the head of the other alternately, and place one plate of skins as squarely as possible over the other until the press is full. It will be seen that the pressure comes directly on the parts of the skins that need it most. After the skins have been pressed, throw them into a drum with warm salt water and drum them until they have all come apart and are well opened out. They are then in right condition to have the pickle removed or to be tanned in pickled condition.

PROCESSES OF CHROME TANNING.

For this process of chrome tanning it is not necessary to remove the acid pickle from the skins, but the grease should be removed from them. To accomplish the removal of the grease the skins should either be pressed or wrung. Pressing is done

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with a hydraulic press. After they have been pressed the skins should be drummed in salt water to separate them and to open them out and soften them. Then they are ready to be tanned. If the grease is to be removed by wringing, the skins should be wrung, then drummed in salt water and wrung again, and then drummed in salt water and wrung again. After they have been pressed or wrung, the skins are put into a drum with a solution of two pounds of Glauber's salt and eight gallons of warm water (85 degrees Fahr.) for each hundred pounds of skins in the pack. The skins should be drummed for thirty minutes, the liquor then drained off and ten pounds of salt and eight gallons of water put into the drum for each hundred pounds of skins. The drum should then be closed and run fifteen minutes. Concentrated one-bath chrome liquor should then be poured into the drum and the skins drummed until they are tanned which usually takes from three to four hours. Three gallons of tan liquor will tan one hundred pounds of skins. At the end of three and a half hours dissolve in as little water as possible eight ounces of bicarbonate of soda for each one hundred pounds of skins and add this solution to the contents of the drum and run the drum for forty minutes. If the liquor in the drum still shows a deep green color another half pound of bicarbonate of soda may be dissolved and added to the contents of the drum, and the skins milled for thirty minutes longer. The skins may be left in the liquor over night, enough water being added to the liquor to cover them. The skins may then be taken out of the drum and allowed to press and drain for twenty four hours and then run through a putting-out machine and shaved. After this has been done put them into a drum with a solution of borax, two pounds of borax for each hundred pounds of skins, and wash for twenty minutes. On removing the skins from the borax wash they are washed for a few minutes in clear water, and they are then ready to be colored, fat-liquored, dried and finished.

Tanning with Sulphate of Alumina and Chrome Liquor.—A very satisfactory method of tanning pickled sheep and lamb

skins with one-bath chrome liquor consists of first tawing them with sulphate of alumina and salt and then tanning them with the chrome liquor. In this way a leather is made that has plump body and fine, smooth grain. When this process is used, it is necessary to remove the acid from the skins before the sulphate of alumina and salt are applied to them. To accomplish the removal of the acid the skins are stirred about in a warm drench of sour bran and salt for a few minutes; they are then ready for the first part of the tanning process.

The usual formula for the preliminary tawing is three pounds of sulphate of alumina and six pounds of salt for one hundred pounds of skins. These materials are dissolved in six gallons of lukewarm water and the solution is put into a tanning drum with the skins, and the drum is then set in motion and run for forty minutes or until the skins have acquired the right degree of plumpness and smoothness of grain. The sulphate of alumina does not act as a tanning agent in this process as it is washed out before the leather is dried and finished. It is used to plump the skins and together with the salt to prevent drawing or puckering of the grain and contraction of the fibers.

After the skins have been drummed for forty minutes in the solution of sulphate of alumina and salt, one-bath chrome liquor is poured into the drum and they are drummed in the combined liquors until they are tanned. Three gallons of concentrated chrome liquor mixed into three gallons of warm water will tan one hundred pounds of skins. This solution is divided into three portions, one of which is added to the contents of the drum at the end of the forty minutes' preliminary tawing, and the drum is run thirty minutes, then a second portion is added and the drum is run one hour, then the third portion is added and the drum is run for two hours, at the end of which time the skins should be tanned through. They should be left in the liquor over-night in order to give the chrome salts taken up by them time to take full effect upon the fibers. The next morning the skins are washed in water containing one-half pound of borax for each hundred pounds of tanned skins.

In this water the skins require to be washed fifteen minutes, after which it is necessary to again wash them for fifteen minutes in clean cold water. The washing of chrome-tanned skins is an important process and it cannot be slighted or omitted if satisfactory leather is to be made. After they have been washed, the skins are ready to be struck out, shaved and colored.

Pickled sheepskins may be tanned in the following manner: Weigh them and for each hundred pounds prepare two solutions. Dissolve by boiling three pounds of sulphate of alumina in five gallons of water. In another vessel dissolve by boiling three pounds of sal soda in five gallons of water. Pour the solution of sal soda slowly and with constant stirring into the solution of sulphate of alumina, allowing a few moments for the foaming to subside. The two solutions combined form a milk-like liquor. This should be allowed to cool before it is used, or enough cold water may be added to reduce the temperature to 85 degrees Fahr.

Throw the skins into the drum with a solution of salt made by dissolving ten pounds of salt in five gallons of water for one hundred pounds of skins. Drum the skins in this solution for ten minutes, then give them the white liquor described above and run the drum thirty minutes. At the end of thirty minutes add one gallon of full-strength chrome liquor to the contents of the drum and run the drum thirty minutes, then pour into the drum another gallon of chrome liquor and drum the skins one hour, then add another gallon to the liquor in the drum and let the drum run an hour or two longer or until they are struck through with the green liquor. To complete the tanning add one pound of salts of tartar dissolved in a gallon of hot water and run the drum one hour, then pour into the drum enough cold water to make the liquor cover the skins well and let them remain in it until the next morning. After being removed from the drum, the skins should be allowed to drain for twenty-four hours, then wash them in a weak borax bath and next in clean water until all salts are washed away and the leather is neutral to the taste.

DYEING CHROME-TANNED SHEEPSKINS BLACK.

For each hundred pounds of shaved skins dissolve by boiling in twelve gallons of water

Logwood crystals $1\frac{1}{2}$ pounds.

Let the liquor cool down to 150 degrees Fahr. and then drum the skins in it twenty minutes. While the skins are being drummed dissolve by boiling in three gallons of water

Blue nigrosine..... 3 ounces.

When the twenty minutes are up add this solution to the logwood liquor in the drum and run the drum fifteen minutes. Then dissolve by boiling in three gallons of water

Copperas 2 ounces.

Bluestone..... $\frac{1}{2}$ ounce.

Pour this solution into the drum and let the skins process fifteen or twenty minutes, then wash them for ten minutes in clean warm water so as to remove all traces of copperas. They should then be wrung, pressed or struck out and prepared for fat-liquoring.

A deep black can be obtained on chrome-tanned sheepskins by the following method: For each one hundred pounds of skins washed and shaved boil in eight gallons of water

Logwood crystals $1\frac{1}{2}$ pounds.

When the dye is dissolved add cold water to make twelve gallons of liquor. Then dissolve

Extract of fustic paste 4 ounces

in two gallons of water and add it to the logwood liquor and stir well. Put the skins into the drum with three gallons of water for each hundred pounds of skins and run the drum ten minutes to wet them. Then pour in the logwood-fustic liquor at a temperature of 120 degrees Fahr. and run the drum twenty minutes. In the meantime dissolve in a quart of water, for each hundred pounds of skins,

Bichromate of potash..... 1 ounce.

Add two quarts of cold water and, without stopping the drum, pour the solution into it and run it ten minutes. Then drain

the drum and wash the skins in three changes of warm water; then prepare them for the fat liquor.

A good black is obtained on chrome-tanned skins by drumming them in logwood liquor, then striking the color with titanium-potassium oxalate. For one hundred pounds of skins dissolve by boiling in twelve gallons of water one and a half pounds of logwood crystals, then dissolve four ounces of fustic paste in two gallons of hot water and add it to the logwood liquor. Drum the skins in this liquor for twenty minutes. In the meantime dissolve six ounces of the titanium salt in a pail of warm water and at the end of the twenty minutes pour this solution into the drum and treat the skins ten minutes. A deep black results. Wash and fat-liquor in the usual way.

If this process of dyeing is used take for each hundred pounds of skins the following articles:

Logwood crystals	1½ pounds.
Carbonate of potash.....	3 ounces.
Alum	4 ounces.
Copperas	2 ounces.

Boil the logwood crystals in ten gallons of water, add the potash and cool the liquor to 150 degrees Fahr. Drum the skins in this liquor twenty minutes, then add the alum dissolved in a pail of water and run the drum ten minutes. Finally, to set the dye, pour through the axle the copperas dissolved in a gallon of water and let the drum run ten minutes longer. Wash the skins to remove all the dye, press and fat-liquor them.

The following process consists of giving the skins a tannin mordant and then coloring the flesh sides blue and the grain sides black by means of methyl violet aniline, aniline black and titanium-potassium oxalate. Retan the skins and mordant the grain by using from one to two pints of palmetto extract for each hundred pounds of skins. Dissolve the extract in six gallons of hot water, drum the skins in the liquor twenty minutes. Or use from three to four pounds of sumac extract and six gallons of hot water. After the skins have been given the tannin, give them eight ounces of methyl violet aniline boiled and dissolved

in six gallons of water. Then drum the skins for fifteen minutes in a solution of aniline black, using four ounces for each hundred pounds of skins. Finally add four ounces of titanium salt dissolved in hot water, run the drum fifteen minutes, wash, press and fat-liquor the leather.

Sheepskins that have been colored and finished can be dyed black and refinished in the following manner: Drum the skins in hot water in a drum for at least half an hour to remove the finish and prepare the leather to receive the dye. Then for each dozen skins dissolve six ounces of permanganate of potash in six gallons of warm water. Put this solution into the drum with the skins and run the drum fifteen minutes, then without stopping the latter add to the liquor in it one pound of log-wood crystals dissolved in ten gallons of hot water and run the drum one-half hour. When the half hour is up pour into the drum a solution of one ounce of copperas and one-half ounce bluestone and run it ten minutes longer, then wash the skins in two changes of water, set them out, oil the grain and dry them out.

FAT-LIQUORS FOR CHROME-TANNED SHEEP AND LAMBSKIN LEATHER.

1. For each dozen skins to be fat-liquored use

Egg yolk	1 pint.
Flour.....	1 pint.
Olive oil.....	$\frac{1}{2}$ pint.
Castile soap	4 ounces.
Water.	8 gallons.

Chip the soap into the water, boil until dissolved and stir in the oil. Boil the mixture of soap and oil, cool down to 110 degrees Fahr. and add the egg yolk. Mix the flour into a thin paste with cold water, taking care that no lumps are left in it, and add to the soap, oil and egg mixture. Mix thoroughly and give to the skins at 110 degrees Fahr., drumming them in it for three-quarters of an hour. This is an excellent fat-liquor for glove leather.

2. To make a barrel of fat liquor, use

Palermo fig soap	10 pounds.
Neatsfoot or cod oil	4 gallons.
Egg yolk	10 pounds.
Common salt	2 pounds.

Put the soap into a clean barrel with just sufficient water to cover it. Apply steam and boil and stir until the soap is dissolved. Stir into the oil to cut it a few ounces of sal soda or borax and add it to the soap solution. Stir the mixture for a few moments until the oil and soap are completely mixed, then run in forty gallons of cold water to cool the emulsion. Then stir in the egg yolk and salt. Stir the whole again and apply to the skins at a temperature of 75 degrees Fahr.

Twenty gallons of this fat-liquor is sufficient for ten to twelve dozen skins. It should be added a pailful at a time to the skins, and the quantity used can be varied to suit the tanner's judgment. It gives excellent results on light upper leather and glove stock. Care should always be taken to cool off the soap and oil emulsion before adding the egg yolk to prevent coagulation of the albuminous constituents of the egg which results when the latter is added to water at a temperature higher than 75 degrees Fahr.

3. For each dozen skins for dull finish use

Castile or fig soap	$\frac{1}{2}$ pound.
Neatsfoot oil	1 pound.
Ammonia	2 ounces.

Boil the soap in three gallons of water, and when it is dissolved add the oil, boiling the mixture one-half hour. Use at a temperature of 150 degrees Fahr., and just before putting it into the drum add the ammonia to the fat-liquor. Drum the skins in the emulsion thirty minutes, then let them press and drain until the next day. Cod oil may be substituted for neatsfoot with equally good results.

4. For fifty gallons of fat-liquor use

Light English sod oil...	40 pounds.
Palermo fig soap.....	20 pounds.

Boil the soap in twelve gallons of water; when it is dissolved

add the oil, stirring and boiling the mixture for several minutes, then run in enough water to make fifty gallons of fat-liquor. Use three-fourths of a pail for each dozen skins.

5. For each dozen skins in the pack to be fat-liquored use

Treated cod oil	1 pound.
Salts of tartar.....	2 ounces.
Strong ammonia	2 ounces.

Boil the oil and salts of tartar in three gallons of water for twenty minutes, then add the ammonia. Drum the skins in the liquor thirty minutes. A gallon or two of cold water can be added to the oil emulsion before the ammonia is put in.

6. For each dozen of skins use

Egg yolk.....	1 pint.
Neatsfoot or olive oil	$\frac{1}{2}$ pint.

Apply to the skins lukewarm and drum thirty minutes.

7. For two hundred pounds of colored skins use

Peerless oil soap	8 ounces.
Olive oil	2 pounds.
Treated cod oil	2 pounds.
Birch oil.....	2 ounces.
Salts of tartar.....	3 ounces.

Boil the soap, olive and cod oils in a few gallons of water until dissolved, then add the birch oil. Stir the emulsion thoroughly, then add to it the salts of tartar dissolved in two quarts of hot water. Add water to make fifteen gallons of fat-liquor and give to the skins at a temperature of 160 degrees Fahr. This fat-liquor is especially good for skins colored with alizarine dye.

8. For one hundred pounds of skins use

Palermo fig soap.....	$\frac{1}{2}$ pound.
Neatsfoot oil.....	$1\frac{1}{2}$ pounds.
Moellon degreas.....	$1\frac{1}{2}$ pounds.
Salts of tartar	2 ounces.

Boil the soap and oil in four gallons of water, then put in the moellon degreas and stir thoroughly. Dissolve the salts of tartar in a little water, add to the emulsion and stir hard. Run in enough water to make twelve gallons of fat-liquor and apply it to the skins at 150 degrees Fahr. This is suitable for glove leather.

METHODS OF COLORING CHROME-TANNED SHEEPSKINS.

A liquor composed of fustic extract and gambier makes an excellent mordant for aniline dyes. For each hundred pounds of skins, weighed after shaving, use two pounds of gambier and one pound of extract of fustic. Dissolve by boiling in four gallons of water, then cool the liquor down with cold water to make twelve or fourteen gallons. Put the skins into the drum with the gambier and fustic liquor and run the drum forty minutes. While the skins are drumming dissolve four ounces of titanium salts (titanium-potassium oxalate) in hot water, and at the end of the forty minutes add the solution to the liquor in the drum and run the drum ten minutes. Then wash the skins and apply basic aniline dye, and when they have taken up the color, wash and fat-liquor them. If an acid dye is to be used, the skins need not be washed after they have been mordanted with gambier, fustic and titanium salts. And if the mordant is all taken up by the skins no washing is necessary; simply drain the liquor out of the drum and apply the aniline solution. This is a good process for any shade of tan and brown.

The tanning material most commonly used in coloring chrome-tanned sheepskins is sumac. Upon some small and medium-size skins four ounces of liquid extract of sumac may be used for each dozen. The sumac is mixed with water at a temperature of 110 degrees Fahr., and the skins are drummed in the liquor so prepared for twenty minutes. Then pour into the drum the solution of titanium salts, run the drum ten minutes, and then color with acid dyes without washing the skins, or wash them and apply basic dye. Dry powdered sumac may be used. After the skins have been washed and shaved they are run in a drum in a bath of warm water of 110 degrees Fahr. to which about two pounds of the sumac have been added. The particles of sumac serve the useful purpose of taking up whatever grease there may be upon the grain as well as acting as a mordant by giving up tannic acid.

An excellent shade of tan is obtained on chrome sheepskins

in the following manner: The skins, washed and shaved, are put into the coloring drum with fourteen gallons of water at 110 degrees Fahr. for every hundred pounds of leather. The drum is started and two pounds of fustic extract, lemon shade, dissolved in hot water, is run in through the hollow axle. After the skins have been run in this solution for thirty minutes four ounces of titanium salts are dissolved in hot water and poured into the drum and the leather is drummed fifteen minutes longer. The coloring is then complete and the skins are then washed and fat-liquored.

If a dark tan is wanted use this formula. Dissolve four pounds of fustic extract, red shade, in four gallons of boiling water, then add enough cold water to make fourteen gallons of liquor for one hundred pounds of skins. Drum the skins in this liquor thirty minutes, then without stopping the drum pour through the hollow axle a solution of six ounces of titanium-potassium oxalate and let the drum rotate fifteen minutes longer, then take the skins out of the drum, wash and fat-liquor them.

If chocolate brown is wanted, put the leather into the drum with a solution of two and one-fourth pounds of fustic extract, lemon shade, and ten ounces of hypernic extract, the two extracts being dissolved so as to make fourteen gallons of solution for one hundred pounds of leather, dissolve and add three ounces of logwood crystals. Drum the skins in this liquor for one half hour, then pour through the axle of the drum five ounces of titanium salts dissolved in a gallon of hot water and run the drum fifteen minutes longer. At the end of that time the skins will have assumed the brown shade and they should then be washed, fat-liquored and dried.

A rich shade of chocolate brown is obtained by the use of aniline dyes on a tannin mordant in the following manner: Boil until dissolved two pounds of gambier and one pound of extract of fustic in four gallons of water, cool down with cold water to make fourteen gallons of liquor. Drum one hundred pounds of skin in this liquor for thirty minutes, then pour into

the drum four ounces of titanium-potassium oxalate dissolved in a gallon of hot water, and drum the skins fifteen minutes longer. If the mordant has been taken up by the leather, run the liquor off and pour the dye solution into the drum. If the mordant has not been entirely taken up it is best to wash the skins before giving them the aniline dye. For six dozen skins use eight ounces yellow 849 and drum the skins ten minutes, then add one pound chocolate-brown 270, eight ounces bismarck-brown, eight ounces chocolate-brown O, dissolved all together and poured through the hollow axle while the drum is in motion. Run the drum twenty minutes after the color has been put in, then wash the skins, fat-liquor them and hang them up to dry. Extract of sumac may be used as a mordant if preferred, also palmetto extract. The skins may be drummed in the tannin bath, then given the titanium salts, washed and colored by the use of three ounces of chocolate-brown aniline 270 for each dozen.

Formula for a good shade of brown. Use five ounces of liquid extract of fustic for each dozen skins to be colored. Drum them in this liquor twenty minutes, then dissolve two ounces of tartar emetic in hot water and pour the solution into the drum and drum the skins fifteen minutes, then wash them, put them back into the drum and apply a color solution made by dissolving the following dyes: Four ounces of phosphine for leather, one-fourth of an ounce of leather green M, one-half ounce of methyl violet 2 B for each dozen skins. The dyes should be thoroughly dissolved and mixed before they are used. Drum the skins in the color bath twenty minutes, then wash and fat-liquor them. Sumac may be used in place of fustic, also palmetto extract or a mixture of fustic and gambier.

Goldenrod-yellow, bismarck-brown and champagne anilines are valuable in dyeing chrome-tanned skins. A combination of goldenrod-yellow, blue and brown produces a fine shade of tan. Mordant the skins with gambier and fustic, then run into the drum eight ounces of titanium-potassium oxalate for two hun-

dred pounds of skins and run the drum fifteen minutes, then wash the skins and dye them with one and one-quarter pounds of goldenrod-yellow, one-half pound of brown aniline and one-eighth of an ounce of blue or green aniline. Drum them in the dye twenty minutes and they will then be found to have assumed a desirable tan color that is fast to light and very uniform. In place of gambier and fustic from four to six ounces of liquid extract of sumac may be used for each dozen skins to prepare them for the dye.

The popular oxblood or wine color is obtained on chrome sheepskins by following these instructions: Put the pack of skins into the dyeing drum and throw in twelve gallons of water for each hundred pounds to be colored. The temperature of the water should be 130 degrees Fahr. Dissolve by boiling in three or four gallons of water two and one-fourth pounds of hypernic extract, one and one-half ounces of logwood crystals and one-half ounce leather-red for each hundred pound of skins. Start the drum, then pour this color solution through the hollow axle and after the last of it is in the drum run the skins in it for one-half hour. Dissolve in hot water four and one-half ounces of titanium-potassium oxalate and pour into the drum and let the drum rotate fifteen minutes longer. The skins, at the end of that time should have assumed the desired color and they are then washed and finished.

A good oxblood color can be obtained in this manner: For each dozen skins use from four to six ounces of extract of fustic according to the size of the skins. Dissolve this in sufficient water to drum the skins nicely, use at a temperature of one hundred and ten degrees Fahr. and drum them in the liquor for fifteen minutes. Then add to the liquor in the drum two ounces of tartar emetic for each dozen skins and run the drum fifteen minutes longer. Wash the skins and prepare a color bath at 120 degrees Fahr. Use from two and a half to three ounces of aniline dye amaranth 3/R for each dozen skins and drum in this twenty minutes, then wash and fat-liquor them.

The shade can be darkened by using two ounces of the amaranth aniline and one ounce of chocolate-brown for each dozen skins. When tartar emetic is used nothing else is needed to fasten the color upon the leather, but when it is not used one ounce of bichromate of potash should be dissolved and poured into the drum after the leather has been drummed fifteen or twenty minutes in the dye, the drumming then continued for ten minutes. This will set the dye upon the leather. A liquor made of fustic and peachwood extracts is an excellent mordant for wine color. The skins are drummed in this twenty minutes, then titanium salts are run in, they are then drummed ten minutes, then washed and colored by the use of amaranth aniline to which one-eighth of an ounce of malachite-green has been added.

Alizarine-brown and yellow fustic produce a fine shade of color suitable for shoe and glove leather. No tannin mordant is necessary as the alizarine dyes color chrome skins without a mordant. Take a lot of skins after they have been shaved and weigh them. For each hundred pounds dissolve twelve ounces of alizarine leather-brown B No. 9052 by boiling in six gallons of water. Be sure the dye is all dissolved. When it is dissolved add enough cold water to make twelve gallons of liquor. Use this dye at 165 degrees Fahr. Put the skins into the drum, start the drum and pour the dye through the hollow axle, then drum them in the dye thirty minutes. While the skins are being drummed in the alizarine dye dissolve one quart of extract of yellow fustic in one gallon of hot water and at the end of the thirty minutes pour the solution into the drum and run it fifteen minutes longer. Drain off the spent dye liquor; wash and fat-liquor the skins.

To get a fine brown a little different from the foregoing but equally desirable use the following formula: Run the skins in water at 150 degrees Fahr. for fifteen minutes, using twelve gallons for each hundred pounds. In the meantime dissolve four ounces of alizarine-brown G in a gallon of water, pour into the drum and run fifteen minutes. Then pour into the drum

four ounces of alizarine yellow R and three-fourths of an ounce of alizarine new yellow extra dissolved in two gallons of water and run the drum fifteen minutes. Next dissolve one pound of extract of yellow-fustic in a pail of water, add to the contents of the drum and run the drum ten minutes. Finally add two ounces of bichromate of potash dissolved in a pail of water and run the drum fifteen minutes longer. Rinse the skins in warm water and they are ready to be fat-liquored.

To color chrome sheep a nice shade of green use five ounces liquid extract of fustic per dozen or the same quantity of liquid extract of sumac for the bottom, drumming the skins in this for fifteen minutes, then add a solution of titanium salts, drum ten minutes, then rinse the skins and color them by using three ounces per dozen of either leather-green special or dark green M and one and one-half ounces amaranth 1/R. Drum the skins in this dye twenty minutes; then wash and fat-liquor them.

Or use this process: Drum the skins for fifteen minutes in four ounces per dozen, extract of sumac in water at 110 degrees Fahr. Then add to the same bath four ounces titanium salts for each hundred pounds of skins dissolved in a pail of hot water and run the drum ten minutes. If the mordant appears to be entirely taken up, drain the liquor out and put in the color solution as directed in the foregoing formula. Run the skins in the dye twenty minutes or longer and then wash and fat-liquor them.

If a dark olive-green color is wanted take the skins from the shavers and for each hundred pounds use ten gallons of hot water and wash them in this fifteen minutes, then drain the drum. Pour into the drum three pounds of extract of fustic dissolved in twelve gallons of hot water and run the drum one-half hour. Then take twelve ounces of copperas dissolved the day before, allowed to settle and the clear liquor taken off. Pour half of this liquor into the drum and at the end of fifteen minutes' drumming look at the skins. If they are dark enough wash and fat-liquor them; if not dark enough add more copperas liquor and run fifteen minutes longer, then wash them very thoroughly and give them the fat-liquor.

YELLOW GLOVE AND MITTEN LEATHER.

Boil twenty five pounds of gambier in a barrel three-fourths full of water, then add one pint of muriate of tin and three ounces of tin crystals and fill the barrel with water. For each one hundred and fifty skins use four pails of this gambier liquor at 95 degrees Fahr. and two pails of water. Drum them in this one hour, then dissolve in two gallons of hot water one-half pound of picric acid and one-half pound of fustic and pour this solution into the drum with the gambier liquor. Let the drum run in the liquor thirty minutes, then rinse the skins, set them out or let them drain and then fat-liquor them. This process produces a nice light yellow color that is in demand for gloves and mittens.

Another good formula for yellow glove leather is as follows: Dissolve a pound and a half of yellow fustic and five ounces of tin crystals in five gallons of boiling water for each hundred pounds of skins. Run them in this twenty minutes, then add five ounces auramine II in three gallons of hot water and drum the skins twenty minutes, then take them out and prepare them for the fat-liquor.

COLORING CHROME-TANNED SHEEPSKINS AFTER FAT-LIQUORING.

Prepare a mordant by boiling in five gallons of water two pounds of gambier, palmetto or sumac extracts or one pound of gambier and one pound of fustic extract for one hundred pounds of washed and shaved skins; then add enough cold water to make twelve gallons of liquor. Run the skins in this liquor for fifteen minutes. Then fat-liquor with acid fat liquor, using two or three pounds of the oil in ten gallons of hot water for one hundred pounds of leather. After this has been done, rinse the skins in warm water and then color them.

Dissolve four ounces of titanium-potassium oxalate in a few gallons of hot water and drum the skins in the solution for ten minutes. Then drain the liquor out of the drum; put in the aniline solution; run the drum twenty minutes and then rinse

the skins off in warm water, strike them out and hang them up to dry.

The process may also be carried out by first fat-liquoring them, then running them in a sumac or other tan liquor, then applying the titanium salts and aniline dye. This method of coloring produces nice, uniformly colored skins.

FINISHING BLACK GLAZED SHEEPSKINS.

After chrome-tanned sheepskins have been dyed black and fat-liquored, they should be struck out and the grain oiled very lightly with a mixed oil made by mixing one part neatsfoot and three parts paraffin oil for glazed finish and two parts neatsfoot and two parts paraffin for dull or mat finish. Sheepskins can be made into nice glazed leather without any fat-liquor or oil at all but the usual practice is to fat-liquor them lightly and apply a little oil to the grain; however, care must be taken not to apply too much and make them too soft and spongy. The skins, after receiving the oil, are hung up to dry. The best results are obtained from slow drying in a room, with a temperature of about 80 degrees Fahr. and having a good circulation of air. When the skins are dry, dampen them for staking. The best way to dampen them is to have a tub two-thirds full of warm water and to put about a dozen into the water at a time, leaving them two or three minutes therein, then placing them in a pile, well covered, on the floor or in a box. When they are sufficiently pliable to be staked, stake and tack them on boards to dry. Be sure to stretch them well onto the boards, for a lot of measurement is lost when they are not tacked out nice and smooth. When they are dry, take them off the boards, trim them and prepare them for the seasoning and finish.

Before applying any seasoning, clear the grain with a weak solution of lactic acid. Mix one gallon of the acid into eight gallons of water and rub this liquor well into the grain, then dry the skins and when they are dry put on the seasoning. The following formula will be found satisfactory for black glazed sheepskins:

Ivory Soap.....	1 pound.
Glue	1 pound.
Logwood Crystals	3 ounces.
Nigrosine	4 ounces.
Bichromate of Potash	$\frac{1}{2}$ ounce.
Fresh Blood.....	2 quarts.

Dissolve the soap in eight gallons of boiling water and the glue in eight gallons of water. Dissolve the logwood and nigrosine in two gallons of hot water and add the bichromate of potash. When cold add the blood. Take one quart of the glue solution and one quart of soap solution and mix into the logwood and blood solution. Stir the mixture well and then strain it. Give the skins a light coat of this seasoning and rub it well into the grain. When the seasoning has dried glaze them, then give a second coat of seasoning, dry and glaze again. Oil the glazed surface with warm finishing oil or with a mixture of equal parts of neatsfoot and paraffine oils.

The following formula also produces an excellent seasoning for glazed finish :

Whole Flaxseed.....	2 ounces.
Logwood Crystals.....	2 ounces.
Nigrosine	2 ounces.
Bichromate of Botash	$\frac{1}{2}$ ounce.
Vinette	$\frac{1}{2}$ pint.
Blood	1 quart.
Glycerine	$\frac{1}{2}$ pint.
Carbolic Acid Crystals	1 ounce.

Boil the flaxseed in a gallon of water one-half hour, then strain and add the logwood, nigrosine and potash and boil up again, then cool the solution to 90 degrees Fahr. and stir into it the vinette, blood, glycerine and carbolic acid. There should be two gallons of seasoning; if there is less add enough cold water to make the quantity specified. Apply to the skins and finish them in the same manner as directed in the preceding formula.

Another good formula for a glazed finish is :

Blood Albumen.....	1 pound.
Black Nigrosine.....	5 ounces.
Logwood Crystals	1 ounce.
Wood Alcohol.....	1 gill.

Dissolve the blood albumen in a quart of water over night. Put the nigrosine and logwood into three gallons of water and boil until dissolved. When the solution is cold add the albumen and wood alcohol. Give the skins two coats of this seasoning and glaze them twice. Oil the glazed surface with warm paraffine oils or with a mixture of neatsfoot and paraffine oils.

A good way to clear the grain of greasy matter is to rub into it a solution of black nigrosine and wood alcohol. Dissolve an ounce of nigrosine in one gallon of water and add to this a little wood alcohol. Rub this into the grain of the skins and when it is dry apply the seasoning. The black is deepened by this treatment, and the grain is cleared.

SEASONING FOR DULL FINISH.

Ivory Soap	1 pound.
Flaxseed	$\frac{1}{2}$ pound.
Beeswax	4 ounces.
Black Nigrosine	4 ounces.
Gelatine	4 ounces.
Aloes	2 ounces.
Wood Alcohol	$\frac{1}{2}$ pint.

Put the soap, flaxseed and beeswax into two gallons of water and boil thirty minutes, then add the nigrosine. Dissolve the gelatine in a quart of water and add to the solution. Then dissolve the aloes in the wood alcohol, add this solution to the other, and strain the mixture. After taking the skins from the tacking boards trim them and apply a coat of this dressing, rubbing it in well; then hang the skins up to dry and when they are dry iron them and then give another coat of dressing, but do not iron again. Oil the grain with paraffine oil, and the skins are finished.

FINISHING COLORED SHEEPSKINS.

A clear, bright finish is obtained on colored sheepskins by using a seasoning made of egg-albumen solution, acetic acid, bichromate of potash and water. The proportions are four gallons of egg-albumen solution, one ounce of bichromate of

potash, two quarts of acetic acid and twenty gallons of water. The ingredients should be thoroughly mixed. A light coat is applied to the skins, thoroughly rubbed into the grain, the skins dried in a warm room and then glazed. A second and sometimes a third coat of the seasoning is required. The less seasoning that is used the better will be the finish, as the leather will stand handling better and the grain will show plainly through the finish, which is considered desirable.

There are very good seasoning or glazing liquors on the market that can be bought ready for use. The tanner can buy them and dispense with the trouble of making his own finishes. This course is pursued by many who find it advantageous and convenient. Sheepskins require very little and, for some purposes, no fat-liquor at all to make them sufficiently soft, neither do they need much staking and working, but on the contrary, the less they are staked the firmer are they when finished.

A good seasoning for black glazed sheepskins is made of:

Logwood Liquor.....	6 quarts.
Oxblood	2 quarts.
Orchil.....	$\frac{1}{2}$ pint.
Water.....	1 quart.
Ammonia.....	$\frac{1}{4}$ pint.
Milk	$\frac{1}{2}$ pint.

This produces a regular kid finish.

Glazed Finish on Colored Sheepskins.—A solution of vinegar, bichromate of potash and water is useful in clearing the grain of colored skins for glazed finish. To twelve parts water add one part strong apple or cider vinegar and a little bichromate of potash. Go over the grain, rubbing it in well; then dry and apply a coat of:

Egg Albumen	12 pints.
Bichromate of Potash	$\frac{1}{4}$ ounce.
Acetic Acid	10 ounces.
Water.....	5 gallons.

Dissolve the albumen and mix all together; then add one teaspoonful sperm oil and three pints more of water. Rub the finish in well, dry and glaze. For second seasoning use:

Blood	3 gallons.
Water.....	5 gallons.
Vinette	2 pints.

Apply a coat of this, dry and glaze, and the skins are then finished.

FINISHING SHEEPSKIN GLOVE LEATHER.

Chrome-tanned sheep and lamb skin glove leather may be finished in two different ways. One way to treat the skins is to take them after they have been washed and shaved, and color them with wood or aniline dye, then fat-liquor them, dry, stake and finish them. The final finishing consists of running the grain of the skin on a plush wheel which makes it smooth and gives it a pleasing polish.

The other way is to take the skins out of the tan liquor, press them and shave them, then color and fat-liquor them and hang them up to dry. After the skins are dry let them lie a few days, then put them into a drum with cold water and wash them in it for two hours until they are clean, then let them drain over a horse over night and the next day hang them up to dry. Finish the skins by dampening, staking, drying and polishing the grain on a plush wheel. When the skins are handled this way they work out very soft and with a good color. Coloring and fat-liquoring are done in the usual way. Formulas and instructions are given that will produce leather of the best quality. Popular colors are light and dark-tan, yellow, brown and oxblood. The instructions that are given for these shades may be followed whether the skins are washed immediately after tanning or after they have been dried and staked.

When flour is used in the fat-liquor the skins are made fuller and plumper than when it is not used.

An excellent way to finish glove sheepskins is to dry them after staking, then put them into a drum with powdered soap-stone and drum them in it for two hours, then take them out, stake them again, and they are finished.

FLESH-FINISHED CHROME SHEEPSKINS.

For some purposes chrome-tanned sheepskins finished upon the flesh with a soft velvety finish are wanted. For this class of leather, skins that have a defective grain are used since the value of the leather does not depend upon the quality of the grain. These skins are used chiefly in the manufacture of gloves and mittens, but they are also suitable for many other purposes.

The skins, taken in pickled condition, are pressed to remove the grease; they are then drummed in warm hyposulphite of soda solution. For each hundred pounds of skins a solution of ten pounds of hyposulphite of soda in twenty gallons of water is prepared; temperature when used 95 degrees Fahr. The skins are drummed in this solution for forty minutes. The drum is then drained and the chrome tanning liquor is put in. The skins require five pounds of salt, three gallons of concentrated chrome liquor and ten gallons of water for every hundred pounds of skins. The salt water and one gallon of chrome liquor are put into the drum and the skins are drummed in the liquor one-half hour; then another gallon of chrome liquor is poured into the drum and the drumming is continued one-half hour, then the third gallon of chrome liquor is put in and the skins are drummed two hours or until they are tanned. A few ounces of salts of tartar dissolved in hot water are then poured into the drum and the skins are drummed one hour longer. They are then piled down for twenty-four hours, then run through the fleshing machine or shaved, after which they are washed in borax water and then in clear water the same as grain-finished skins. Another good tanning process is as follows: For each one hundred pounds of skins, three pounds of sulphate of alumina, five pounds of common salt and four pounds of Glauber's salt are dissolved in six gallons of warm water, and the skins are drummed in the solution forty minutes. Chrome tanning material is then poured into the drum and the skins are drummed until they are tanned. Three gallons of concentrated chrome liquor will tan one hundred pounds of

skins. When they are tanned, the skins should be left in the liquor over night, then drained for twenty-four hours, shaved and washed. Nice flesh and grain finished skins can be made by using a preliminary solution of sulphate of alumina and borax, six pounds of the former and three pounds of the latter, dissolved in ten gallons of water being used for one hundred pounds of skins. First, however, the pressed skins are run in a solution of eight pounds of salt and six gallons of water for twenty minutes. The solution of sulphate of alumina and borax is then poured into the drum, which is then run forty minutes. Chrome liquor is then poured into the drum, and the skins are tanned as in the preceding process.

Treatment after Tanning.—After the skins are washed they are put into a drum with four gallons of water and five pounds of pipe-clay for one hundred pounds of skins and drummed therein twenty minutes. They are then run on a wet wheel, which gives a good face to the leather. After the skins have been faced they should be run in warm water for fifteen minutes; they are then in condition to be colored.

Coloring and Fat-Liquoring.—The coloring is done in the same manner as upon grain-finished skins. Fustic, gambier, sumac or other dyeing material is used as a mordant for aniline colors. Or alizarine dyes may be used; also fustic and other natural dyestuffs in conjunction with titanium salts. Receipts for many desirable shades have already been given; they need not be given again.

As a fat-liquor an emulsion of egg yolk, olive oil, castile soap and flour is especially suitable. The formula for this will be found in the section devoted to fat-liquors for sheepskins. Drying and staking are done in the usual manner. Staking on a machine should be followed by knee staking so as to get all the stretch out. The skins are then given a light run on a very fine emery wheel, and they are then ready to be trimmed and sorted. If the work has been properly done the finished skins are very soft, evenly colored and with a smooth, velvet-like face. Finishing on fine emery removes all roughness and

makes the skins soft and smooth. Acid fat-liquor is suitable for these skins.

If white skins are wanted the tanning process is followed by a treatment with flour, fat-liquoring and finishing being then proceeded with in the manner already described.

DRENCHING AND PICKLING SHEEPSKINS WITH FORMIC ACID.

After the skins have been taken out of the lime and washed and fleshed they are in suitable condition to be drenched. Washing after fleshing should be done in warm water, 95 degrees Fahr., and the more the skins are washed, the less acid will be necessary.

Formic and lactic acids in the proportion of four parts of the former and one part of the latter should be used, as the combination produces better results than formic acid alone. Of the mixed acids, about one-fourth of a pint is added to water in a paddle-wheel, this quantity being used for one hundred skins. The water should be at a temperature of 90 degrees Fahr., and it should be thoroughly plunged or stirred after the acid is added to it. The skins are run in the drench for fifteen minutes, when another fourth of a pint of mixed acid is added and the skins are pressed fifteen minutes longer. This quantity of acid, namely, one-half pint, is the maximum quantity for one hundred heavily-limed skins. In many cases less acid will suffice. Too much acid causes the skins to swell and the grain to pipe. Heavy skins may be drenched from thirty minutes to an hour. It is always best to add the acid in two or three portions at intervals of fifteen minutes rather than to add the full quantity before the skins are put into the drench. The skins should become soft and thin in the drench. And when they have attained this condition, wash them in cold water and then place them in a light sour bran drench for the purpose of opening them and removing the last trace of lime that may remain in them after the acid drench.

Bran drenching may be done during the day or during the night. When done during the night the skins will be found at

the surface of the drench the next morning, and they should then be washed and pickled.

When bran previously soured is used, about one-half the usual quantity will suffice for these skins. Or the drench can be made by using two pecks of bran, adding to it sufficient warm water in the paddle to cover the skins. The skins are thrown in and pushed down, and the vat is then covered to retain the heat and left until the next morning. The bran should be mashed with water in a tub before it is used; and the temperature of the drench should be 90 degrees Fahr. The skins will rise to the surface of the liquor during the night; in the morning take them out, wash and scud them if they require it, and then pickle them. It is not necessary to accomplish the complete deliming of the skins in the acid drench, as the sour bran will remove whatever lime the skins retain.

Pickling is done in the following described manner: Prepare an acid bath by adding from twelve ounces to one pound of formic acid to twenty-five gallons of water. Paddle the skins in this solution for several hours; then put them into a fairly strong salt water for thirty minutes, which completes the process. Pickling can also be done by drumming the skins in a 0.25 per cent. solution of formic acid for thirty minutes, then putting them into a solution of salt for one-half hour or longer.

Skins pickled with formic acid have a darker color than skins pickled with either sulphuric or acetic acid, due to iron in the acid, and are therefore not so attractive in appearance, but they are thoroughly pickled and can be kept for a long time without spoiling.

Pickling with Acetic Acid.—Acetic acid may be used to pickle hides and skins, in place of sulphuric acid, which is generally employed. The process may be carried out in a drum by using fifty pounds of salt, one pound of acetic acid and sufficient water to process the skins nicely for one hundred hides or a proportionate number of skins. The skins should be processed at least one hour and may be left in the solution several hours without injury.

Upon skins that are thoroughly drenched, acetic acid produces a clean grain and preserves them, as well as putting them into excellent condition for tanning, and there need be no fear of burning the grain or fiber.

When a paddle wheel is used, the skins are best pickled by being run in a 0.15 per cent. solution of acetic acid for several hours, then allowed to drain several hours and then put into a fairly strong salt solution. To process the skins slowly assures the uniform penetration of the acid and the destruction of all germs of decay.

SHEEPSKINS FOR JACKET LEATHER.

Sheepskins intended for jacket or coat leather should be tanned in a chrome process which makes them more waterproof and durable, than by the old-fashioned process of gambier, alum and salt. Starting with pickled skins, the first operation is pressing to remove the grease; then the skins are in condition to be tanned in the following process which is about the cheapest that can be used. For each hundred pounds of skins to be tanned, dissolve one pound of Glauber's salt in eight gallons of lukewarm water. Drum the skins in this solution ten or fifteen minutes. The drum is then stopped, the skins are thrown back upon the pins of the drum, the plug is pulled out and the solution allowed to drain off. The plug is then replaced in the drum, and ten pounds of salt and eight gallons of water are put into the drum with the skins, and the drum is run five minutes. Chrome tanning liquor is then poured into the drum in portions of a gallon at a time, at intervals of one-half hour each, until three gallons have been added to the contents of the drum for every hundred pounds of skins to be tanned. The drum should be run two hours after the last gallon of tan liquor has been put in. In as little water as possible one-half pound of bicarbonate of soda is dissolved and added to the contents of the drum and the skins are drummed one-half hour longer. If at the end of this time the liquor in the drum still shows a deep green color, another half-pound of the soda may be dissolved

and added to the contents of the drum and the skins drummed another half-hour. The tanning should now be completed, but if any doubt exists in the mind of the tanner, the skins may be drummed longer or they may be allowed to remain in the liquor over night, enough water being added to the tan liquor to cover the skins. They should then be removed from the drum and allowed to press and drain for twenty-four hours. After pressing and draining, the skins are thrown into a drum with a solution of borax or bicarbonate of soda, about two pounds for one hundred pounds of skins, and washed therein for one-half hour; they are then washed in clean water; pressed, shaved and colored.

Coloring is done in the same manner as for other black chrome sheepskins, after which the skins are fat-liquored. The fat-liquor should consist of soap and oil, and the grain of the skins should be oiled with neatsfoot or cod oil, and the skins should then be dried. Finishing consists of staking, tacking, seasoning and ironing or rolling. The finish should be a dull one. Boil one-half pound of Irish moss in one gallon of water to which one-quarter ounce of blue vitriol has been added. Boil several hours until well cooked, adding water from time to time to keep the solution up to the required quantity. To this solution add one-quarter ounce of potash and one-half ounce of prussiate of potash, which should be dissolved in a little water and poured in cold. For the above mixture boil one ounce of black nigrosine in one gallon of water and add it to the moss solution. Strain the finish; apply it to the skins and while they are still damp iron or roll them. An old process of tanning jacket leather consists of gambier, alum, salt, soda and picric acid. The fat-liquor is an emulsion of soap, oil and degreas. Finishing consists of applying a dull dressing, then ironing the skins and oiling the grain, which helps to make it waterproof.

WHITE SHEEP LEATHER.

For soft white leather that is suitable for any purpose for which such leather is required, tanning with sulphate of alumina

and bicarbonate of soda in the following manner will be found a satisfactory process. The pickled skins should be soaked in salt water to remove all wrinkles and then hung up and dried. If the tanner prepares his skins himself he should take them out of the pickle and hang them up to dry in such manner that they will not dry with wrinkles in them. It is also advisable to wring or press the skins before drying them so as to remove as much grease from them as possible. When the skins are dry, they are degreased in naphtha and then dried, softened in a drum with salt water and then tanned. After the skins have been degreased and the naphtha evaporated, put them into a drum with ten gallons of water, in which have been dissolved one pound of Glauber's salt and three pounds of common salt for each hundred pounds of pickled skins. Let the skins drum in this solution for fifteen minutes, then drain the solution out of the drum. Then put into the drum ten gallons of lukewarm water and four pounds of salt, and drum the skins in this solution for ten minutes. There should have been prepared several hours or a day before the tanning liquor made as follows: Boil until dissolved in ten gallons of water, twelve pounds of sulphate of alumina. In a clean pail dissolve by boiling in a gallon of water one and one-half pounds of bicarbonate of soda. Pour the soda solution slowly and with constant stirring into the alumina liquor, taking care to pour it very slowly and to allow intervals for the effervescence to subside. Use the white liquor that results when it has become cool. After the skins have been running in the salt water for ten minutes, pour into the drum without stopping it, one-half of the alumina and soda liquor and drum the skins in it for three hours; then horse them up smoothly over night and the next day hang them up to dry. When they are dry, put the skins back into the drum with eight gallons of water and run the drum ten minutes; then pour into the drum the rest of the alumina and soda liquor and drum the skins in it for three hours, more or less, depending upon how thick they are. Then let the skins drain on a horse until the next day when they should be hung up to dry.

Moisten and stake one or two skins to see how soft they are. For some purposes they will be found to be soft enough; but if softer skins are wanted dampen them with water and fat-liquor them with sulphated oil or acid fat-liquor as it is called, made of castor oil and acid. This material makes the skins very soft without discoloring them. It must be made with great care and attention or bought ready made. It dissolves readily in warm water and quickly penetrates into the skins. One hundred pounds of dry skins should be given from four to seven pounds of the oil according to how soft the leather is wanted. Stir it into eight gallons of water at 95 degrees Fahr., put this into the drum with the dampened skins and run the drum thirty minutes; then let the skins drain over night. The next day set the skins out on the grain and oil off with French chalk, two parts of glycerine and four parts of water. Apply this mixture to the grain, then hang the skins up to dry.

When the skins are dry, let them lay in the crust or dry condition ten days before staking them. After staking, tack the skins on boards. If they do not appear to be fully tanned or if they are not soft enough, they can be moistened and retanned or given more of the fat-liquor as they seem to require. Sheepskins, however, will be found well tanned and very soft after the last staking and not in need of retanning or refatliquoring.

Tanning with Alum and Salt.—For this process the pickle in the skins must be removed before tanning. Take the pickled skins and wring or press them very thoroughly to remove the animal grease; then wash them in warm salt water to soften them and to free them from surface grease. The acid pickle is removed with a bath of whiting and salt. For ten dozen medium-sized skins use twenty-four quarts of salt and four pounds of whiting in water at 90 degrees Fahr. Drum the skins in this bath twenty minutes, then let them remain in the bath without drumming for about an hour, after which let them drain an hour or two. Then throw the skins into a light, sour bran, drench for half an hour, adding sufficient salt to keep them from swelling; then wash them in clean salt water until

every trace of whiting and bran is washed away. Use plenty of salt in the wash baths to keep the skins from swelling. Precaution must be taken to wash all the whiting from the skins, or they will be harsh and brittle after tanning. After draining twelve hours, the skins are ready to be tanned.

A tanning solution is prepared as follows : For every hundred pounds of skins, nine pounds of alum and four pounds of salt are dissolved in five gallons of hot water. Thirty pounds of wheat flour are made into a paste with cold water and then mixed with the alum and salt, and enough water is added to make fourteen gallons of material ready for use. This mixture is heated to 90 degrees Fahr., put into a drum with the skins and the drum is run for one hour, or until the skins have absorbed the tanning material. The skins are now removed from the drum and hung up to dry.

When dry the skins should lie in the crust some time before they are finished. Then when they are to be finished, dampen and stake them. If they are soft enough for the purpose for which they are to be used, the skins, after staking, can be tacked out flat on boards and dried, and are then ready for use. If softer skins are wanted, dampen them and drum them in a warm solution of sulphated oil, made by dissolving four or five pounds of the oil in ten gallons of warm water for every hundred pounds of dry skins. Drum the skins in this solution thirty minutes; then set them out, apply a coat of glycerine, chalk and water to the grain and hang the skins up to dry. Dampening and staking complete the process. The finished skins should be perfectly white and soft and free from grease.

Another way to tan with alum and salt is to use from a pound to a pound and a half of alum and twelve ounces of salt for each dozen skins. Dissolve alum and salt together, making a pail of liquor, and drum the skins in this for thirty minutes; then add one pail of flour for each ten dozen skins; run the drum a half hour longer, then dry and finish the skins as described in the preceding paragraph.

Egg yolk can be used to impart softness to the skins. One

quart of fresh yolks is sufficient for ten dozen small skins. It is put into the drum with the flour; or the tanning mixture can be made of alum, salt, flour and egg yolk, the skins drummed in it, then dried and finished.

White lamb and sheep skins should be buffed on the flesh by the use of an emery wheel to get rid of all loose flesh and make the skins soft and smooth.

Skins tanned with alum and salt alone are not as white, neither are they as soft and plump as skins on which flour has been used in connection with the salt and alum. Skins which have received flour stake out easily, the grain does not crack the flesh, when buffed, is white and smooth and the leather is soft and full. The cost of tanning is of course increased by using flour but the better quality of the tanned skins is sufficient to offset the extra expense.

Another Good Process.—Sheep and lamb skins that have had the acid pickle removed can be tanned in the following manner: For every hundred pounds of skins three pounds of sulphate of alumina and six pounds of salt are dissolved in six gallons of water. This liquid is put into the drum with the skins and the skins are drummed in it for thirty minutes. Then a second solution is prepared, consisting of ten pounds of hyposulphite of soda dissolved in five gallons of warm water. This solution is poured into the drum and the skins are drummed in the combined alumina and soda solutions for twenty minutes. The hyposulphite of soda fixes the tannage upon the skin fibers, making it permanent; it however also thins the skins. In order to overcome the thinning of the skins, another solution of sulphate of alumina and salt is added. This consists of two pounds of alumina and four pounds of salt dissolved in three gallons of water, and it is added to the contents of the drum, and the drumming is then continued for thirty or or forty minutes or until the skins have acquired the desired degree of plumpness.

The skins are then taken from the drum and rinsed off by a single dipping of them separately in clean water; they are

then horsed up for several hours to drain. Thoroughly tawed skins are produced by this process; they are insoluble in cold water and even in warm water, and make leather of good quality and fine grain.

After the skins have dried, they may be made softer by drumming them in a warm solution of sulphated oil, then drying and staking them. Although flour does not enter into this process as described, it may be used if considered necessary; but the skins tanned without it work out into nice soft leather, especially when they are treated with sulphated oil. The skins can also be dampened and staked and then retanned in a chrome process. When sulphated oil has been used, no fat-liquor is required. The skins can, however, be tanned in this process, dried, wet back, and retanned in a chrome process, and then colored and fat-liquored, or drummed in flour and fat-liquored, and made into white chrome leather. To wet the skins and retan them in a chrome process and then to bleach them with borax and sulphuric acid is another way to make white chrome leather. If no sulphated oil was used in the preliminary process, it may be applied to the skins after they are chrome-tanned.

WHITE CHROME-TANNED SHEEP LEATHER.

For some purposes, such as baseball covers, suspender trimmings, linings and trimmings, a soft white leather is wanted. Formerly the alum process was used to make such leather, but nowadays the skins are tanned in a chrome process and made white by bleaching and treatment with flour after they are tanned. If it is desired to tan sheepskins for white chrome leather the following instructions will be found of service.

Sheep and lamb skins are always pickled with sulphuric acid and salt before they are tanned, and in the case of white leather this pickling process is of help and importance since it bleaches the skins and makes them whiter than they would be were they not pickled. The grease must be pressed or wrung out as much as possible before tanning is begun or the leather will

not be white but a dirty yellow. It is suggested that the skins be taken in pickled condition and dried out and then degreased with naphtha. After this has been done hang them up until the naphtha has evaporated, then put them into a drum with a warm solution of salt, and run them a few minutes to wet and soften them for the chrome liquor.

For each hundred pounds of skins to be tanned dissolve one pound of Glauber's salt in eight gallons of water. Place this solution in the drum with the skins and run the drum ten minutes, then throw the skins back upon the pins of the drum and drain the solution off. The plug should then be replaced in the drum, and for each hundred pounds of skins put six pounds of common salt and eight gallons of water into the drum and process the skins five minutes. Next add to the contents of the drum the one-bath chrome liquor in portions of one-third of the quantity used at a time, and drum the skins for three or four hours or until they are struck through with the green liquor, three gallons of chrome liquor being used for each hundred pounds of skins. In a gallon of hot water dissolve a pound of bicarbonate of soda, add it to the contents of the drum and run the skins forty minutes. The tanning should now be complete but if any doubt exists in the mind of the tanner, the skins may be drummed an hour longer and left in the liquor over night, water being added to the tanning liquor to completely cover the skins. The next day remove the skins from the drum, place them smoothly over horses and let them press and drain for some hours, the longer the better; they are then ready to be washed and bleached. For each hundred pounds of skins, original weight, use one pound of borax or bleaching soda dissolved in hot water, say at 120 degrees Fahr., and wash the skins in this solution twenty minutes, then drain the water, replace the plug and put into the drum cold water to which some sulphuric acid has been added, and drum the leather in it thirty minutes. The borax opens and softens the skins and being alkaline prevents the acid from doing any injury. After the skins have been washed in the weak acid solution they

should be washed in clean hot water, then pressed or struck out and shaved.

The next process is treatment with flour. - Use about fifty pounds of flour to one hundred large skins or two hundred small ones. Stir the flour into ten or twelve gallons of water for one hundred pounds of skins and drum the skins in the liquor two hours, then strike them out or press them and give them some fat-liquor. For some purposes the skins work out soft enough without fat-liquor but if very soft leather is wanted a little fat-liquor should be used. Nice white skins can be obtained by omitting the borax and acid treatment, simply washing the skins and giving them the flour treatment, but it is the writer's opinion that the whitest skins result when both treatments are used.

Sulphated oil dissolved in warm water is an excellent fat-liquor for these skins. Another consists of soap, oil and egg yolk. and, for a common quality of skin, a soap solution alone makes the skins soft without discoloring them. For very soft and full skins the following fat-liquor is recommended: For each dozen medium-size skins use one pint egg yolk, one pint flour, one-half pint olive oil, four ounces Castile or Ivory soap, eight gallons of water. Boil the soap until it is dissolved, add the oil, and boil the mixture fifteen minutes, cool the liquor to 75 degrees Fahr. and add the egg yolks. Make the flour into a paste with water and stir it into the fat-liquor. Press the water out of the skins, give them the fat-liquor, drumming them in it forty minutes, then strike them out and hang them up to dry. The grain may be oiled with French chalk, two parts of glycerine and four parts of water, or the skins may be dried without the grain being so treated.

When the skins are dry, dip them into clean hot water and place them in piles in a clean place, cover them up and let them become soft and workable, next stake them and then run them in a dry clean drum with powdered chalk or soapstone for one hour or longer. Finally arm-stake the skins and they are then finished. When the work has been properly done the skins work out very soft, full and white.

Four pounds of sulphated oil dissolved in twelve gallons of water at a temperature of 125 degrees Fahr. will fat-liquor one hundred pounds of skins. Drum the skins in the oil thirty minutes, then rinse them in warm water, strike them out and dry them as directed above.

Chrome-tanned skins in the natural greenish-blue color of the process are used for lining purposes. The process of finishing such skins is very simple. They are washed, shaved and fat-liquored. Any fat-liquor that is suitable for sheepskins may be used. Unless the skins are wanted very soft the quantity of fat-liquor given them should be very small. After the skins have been fat-liquored, set them out hard and give the grain a coat of soapstone, water and glycerine. Mix a half-pint of glycerine into a gallon of water and then stir in enough soapstone to make the mixture about as thick as cream. Apply this to the grain of each skin with a sponge and then dry the skins by tacking them out smoothly on boards. When they are dry dampen and stake them, then dry them again, roll or iron them, and they are finished.

WHITE NAPA LEATHER.

The process of tanning sheepskins into what is called Napa leather originated in Napa, Cal. It is more of a curing than a tanning process and may be called a soap and oil process. The leather it produces is possessed of considerable strength and softness and is used for purposes where inexpensive leather is required. Light-weight skins are used. For white leather skins having damaged grains are finished upon the flesh. The original process of making this leather consisted of removing the wool by sweating the pelts and then treating the skins to the tanning or curing process. No lime was used and the skins were thus left flat and with their strength unimpaired. Various modifications of the process have crept in, due to the changed processes of preparing the skins. At the present time the wool is removed with sulphide of sodium or another depilatory. The skins are given very little or no lime at all,

but of course must be thoroughly washed before they are tanned. Pickled skins should be pressed to remove the grease and then drummed in warm salt water to get them in condition to be tanned.

The original process was as follows: For two hundred skins, twenty pounds of salt, thirty pounds of white rock potash and three hundred gallons of water constituted the first part of the process. The skins were left in the liquor for two or three hours, then wrung out as dry as possible and immersed in the second solution. This consisted of twelve pounds of hard soap, two gallons of neatsfoot oil and one hundred and fifty gallons of water. The skins were left in this liquor until it had penetrated them; then they were dried and passed through the process a second, and even a third, time as they seemed to require. After the last drying, the skins were washed in clean water to make them clean and soft, and were then dried and staked.

Pickled skins are partly cured when received at the tannery; and in some instances it suffices to merely neutralize the acid in them. For this purpose soda or borax and oil may be used. For white leather, the skins receive no further treatment, but are dried in a warm room and finished as quickly as possible.

White Napa leather is finished upon the flesh as the grain is usually very imperfect. The dried skins are moistened and staked and, when they are dry and soft, they are buffed on an emery wheel and made clean and soft upon the flesh. This work requires considerable skill to get an even surface and not cut through the skin. When finished, the skins are soft, white and clean.

White skins must be free from the grease natural to sheepskins or they will be a dirty yellow when finished.

Another way to treat the skins that produces results similar to the preceding process is as follows: For ten dozen sheepskins of average size, a solution is prepared composed of two pounds of caustic soda and one pound of borax in sufficient water to cover the skins. The skins are drummed in this solu-

tion for thirty minutes, then hung up and dried. They are next immersed in a liquor composed of five pounds of hard soap, one gallon of straits or neatsfoot oil, one-half pound of caustic soda and seventy-five pounds of water. In this solution the skins should remain until they have become thoroughly softened, after which they are put into a drum with a part of the second composition and run for about a half hour, then removed and dried as before. In many instances this treatment is sufficient.

If the skins are not quite satisfactory after drying the second time, they may be soaked soft in the second liquor or run in drums and passed through the process a second time. Some skins require more treatment than others.

After the skins have become leather, they are put into a weak solution of soap, oil and caustic soda in order to soften them, and when soft and moist they may be colored or dried without further treatment and worked into white leather. The leather is soft and tough, and it does not pull apart after being sewed.

Tanning with Alum, Sumac and Oak Bark.—A soft, light-colored sheepskin that can be used in the natural color of the tan, or colored any desired shade, is desired for many purposes. A process consisting of alum, Glauber's salt, common salt, sumac, oak bark, nutgalls and acid produces such leather.

The pickle should be removed from the skins by drenching them with whiting and salt, then washing the skins in two baths of warm salt water. To make the tanning liquor, dissolve in five gallons of water, six pounds of alum, three pounds of Glauber's salt, four pounds of common salt. In another tub boil in five gallons of water, five pounds of ground sumac, three pounds of oak bark and one pound of ground nutgalls. Mix the two solutions, then strain while the mixture is hot and add to it four ounces of sulphuric acid.

The liquor should be used lukewarm, and the skins should be drummed in it one hour, then allowed to drain twenty-four hours. Tanning can also be done in a paddle-vat, the liquor being used warm and the skins stirred about in it for two hours,

then allowed to remain in it for several hours and then withdrawn and drained.

After draining, the skins should be struck out on both sides and oiled with neatsfoot oil also on both sides, then hung up and dried. As the leather dries it should be worked continually, so that when it is dry it is also soft and well worked out. The skins tan cheaply and quickly, and when worked out can be colored any shade or left in the natural color of the tan. This leather is quite moisture-proof and durable.

Sumac used alone makes leather that is nearly white. When tanned, the skins are dried, worked out and used in the color of the tan or colored with aniline dye.

COLORING BLACK NAPA SKINS.

Black Napa leather is generally colored blue on the flesh side. This may be done by the use of Direct Blue Paste, a paste specially prepared for the purpose. It produces a full, dark blue shade, and penetrates the skins from flesh to grain. This is the method of using it: For ten dozen skins direct from the press, two gallons of the blue paste are dissolved in ten gallons of water, and the skins are drummed in this liquor for three-quarters of an hour, then allowed to lie over night and are tanned the next day. A good blacking for this class of leather is made as follows: Five pounds of nitric acid, five pounds of muriatic acid and one pint of water. Enough wrought-iron chips are used to kill the acid, then seven pounds of copperas are dissolved in five gallons of water and added to the above. A good "sig" is made of forty gallons of water, twelve pounds of salts of tartar, five pounds of bichromate of potash and one quart of ammonia. These formulæ are in practical use and giving good results.

The skins, after becoming dry are moistened and then dampened down for staking. This is usually accomplished by dipping the skins in water and then letting them lie in piles until they become uniformly moistened. When in just the right condition, the skins are knee-staked for the purpose of

softening them and to get rid of all stretch. After this work is completed, the skins are tacked or stretched upon boards in moist condition and left until thoroughly dry. When they are dry they are buffed on emery wheels. Upon the white Napas this is a very important part of the work. The buffing is done to remove the surplus flesh and to make the skins clean and smooth upon the flesh side. The black Napa leather is finished upon the grain in dull and glazed finishes. The dull finish is obtained by ironing the skins while they are slightly moist with seasoning, and for the glazed finish the skins are glazed upon machines.

COLORING ALUM-TANNED LEATHER.

Alum leather may be colored with either wood or aniline dyes. The first are the most durable, but the latter are prettier and are more easily applied as they can be bought prepared in many shades, requiring only to be dissolved in warm water to be ready for use. A mordant is not necessary with the colors as the alum itself acts as a mordant and the color adheres readily to the alum-tanned fibers.

When coloring, care must be taken to extract as little of the tanning material as possible and to apply the color carefully and economically. The dye may be applied to the grain side by means of a brush or sponge which leaves a white flesh and colored grain. Light skins that require thorough coloring and in which softness is required receive a so-called nourishment to make up for the tanning material lost while coloring. A suitable mixture for this purpose is made of alum, salt, flour and egg yolk which can be worked in mechanically or may be applied to the flesh side of the skins or the skins may be kneaded in the mixture. In place of this mixture, water and egg yolk may be used or a solution of sulphonated oil in warm water. When considerable tanning material is removed before coloring, alum and salt should be used in the mixture to replace the material lost. To obtain a fine, dry feel the washed leather may be drummed in a fatty mixture or in a mixture of fat and

wheat flour. Sulphonated oil is good for this purpose. The skins may also be treated with the materials named before they are colored.

To wash the skins for coloring, they are drummed in lukewarm water until they are softened, and feel and look like raw stock; they are then rinsed off and colored. For black skins logwood and striker are used. The skins are then given the retannage or nourishment and are dried and finished. Fine, light skins are generally wanted softer and in brighter colors than heavy skins.

CHAMOIS LEATHER.

Chamois leather at the present time is made almost exclusively from sheepskins. The leather is produced by the action of oil upon the raw skins, and is distinguished from all other classes of leather by remarkable softness and open texture. In the making of this leather the wool is removed from the pelts in the usual way, the skins are then limed long and thoroughly in order to make them very soft and elastic. They are then split on a machine adapted to the work, the grain being tanned and finished into fancy leather, while the flesh side is oil-tanned into chamois leather. After splitting, the fleashes receive a further liming in order to increase their softness and porosity. Old lime liquors, provided they are kept clean, produce the best results, as they make the fibers of the skins very soft and silky without the hardness that comes from the use of new, fresh limes.

To remove the lime from the skins they are subjected to different processes. In some instances they are bated with manure and then given a bran drench, which leaves them perfectly clean and very soft. Some manufacturers remove the lime by thorough washing and without subjecting the skins to a fermented bate at all. This method makes the leather more durable than when a bating process is used. It is very important that all the lime be gotten rid of before the skins are treated with oil.

Before the skins are tanned they are pressed in a hydraulic press in order to get rid of all surplus water and to make them as dry as possible. They are then given a thorough beating in machinery especially constructed for the purpose, in order to soften them, after which they are sprinkled with cod-liver oil and again beaten in order to force the oil into the leather. The best grade of Newfoundland cod oil is considered most suitable for the purpose. The process of oiling the skins and beating them is repeated two or three times, or until they have lost their original smell of lime and have acquired a mustard color. After the oiling and beating process is completed the skins are made to undergo a process of heating. By this process the oxidation of the oil which commenced during the previous process is completed by the fermentation that results, in the skins. The heat is generated spontaneously. The skins must be watched very closely and frequently turned over. When the heat rises to too high a temperature the leather is seriously damaged. The heat that is generated destroys all organic matter in the skins. The highest temperature allowable is 140 degrees Fahr. This heating process is a most delicate operation, and upon its being properly done depends the success of preparing the leather. When insufficient heat is generated the leather rots, when too much heat is produced it becomes dissolved. When fermentation ceases, and the skins are no longer susceptible to heating, they are treated in order to remove the oil. This is done by washing them in hot water and then pressing under a hydraulic press. The grease that is squeezed out in this way is *degras*, an article largely used by tanners. The oil may also be removed by washing the skins in a solution of soda ash, which causes the grease remaining to saponify. This saponified oil is then neutralized with sulphuric acid and forms the oil known as *sod oil*. A certain percentage of the oil should be allowed to remain in the skins so as to give them softness.

The finishing processes consist of drying, staking and smoothing down all unevenness on the surface. The skins may be

bleached by being sprinkled with water and exposed to the sun, or by treatment with a weak solution of permanganate of potash, followed by a treatment with diluted sulphuric acid, or the leather may be treated with sulphurous acid in the form of gas. Methods of treating the skins vary. In some instances the skins, instead of being laid in piles to ferment, are hung up in warm ovens, which is less dangerous and produces a better color. Very soft, tough leather having many of the characteristics of chamois leather is made from fleshers in chrome tanning. The skins may be tanned in the usual way and then very heavily fat-liquored with emulsions of oil, egg-yolk and soap, or of oil and degreas. By first treating the fleshers to a tawing paste of alum, salt, flour and egg yolk, made up in the proportions of nine pounds of alum, four pounds of salt, twenty pounds of wheat flour, and twelve pounds of egg-yolk, for one hundred pounds of skins, and drumming the skins in this liquor in a drum at a temperature of ninety degrees Fahr. for twenty minutes, and then drying them out, and after lying in the dry state for some weeks working them soft, a very soft and elastic leather is produced. They may be finished up with no further treatment other than working and smoothing, or they may be subsequently tanned in a chrome process and then finished by passing the prepared skins (washed and pressed) through a twenty-five per cent. Turkey-red oil solution. After this they are dried and laid in a moderately warmed room in a heap and covered up. They are then hung up in the air and allowed to dry slowly, when they are again oiled in the same solution and again laid in a heap, again dried, and then washed in a weak solution of alkali.

By drying and working, the leather is made soft and completely oil-tanned. The results may be variously modified by greater or less concentration of the oil solution, by higher temperature in drying and by more frequent applications or treatments with the oil. Combinations with the salts of alumina may also be employed here. The preferred method is as follows: The prepared skins are steeped in a solution containing

preferably fifteen per cent. of the soluble Turkey-red oil, they are then dried and the operation is repeated, after which the usual method of tanning is proceeded with.

COLORING CHAMOIS SKINS.

The coloring of chamois skins can be done successfully only in a drum, the tumbling and pounding being necessary to force the dye into the skins. Chamois skins can be dyed through the same shade by mordanting with chrome alum and then coloring with the alizarine or the acid and basic dyestuffs. A practical method of coloring the skins is carried out in the following manner: The skins are first soaked for about half an hour in a one per cent. solution of soda crystals, the temperature of the water being about 90 degrees Fahr., for the purpose of removing any oxidized oil that may be on the skins. When they are soaked and softened, the skins are washed very thoroughly in warm water in a drum to remove the soda; they are then slicked out and are ready to be mordanted and dyed. The mordant consists of a one per cent. solution of chrome alum, used warm, and the skins are run in it in a drum for thirty minutes. The skins are then taken from the chrome alum solution and dyed without washing, or they may be thrown back upon the pins of the drum, the mordant solution drained off, and the dye-liquor put into the drum. The quantity of dye required for each dozen skins is about two ounces of the powder alizarine dyes and about ten ounces of the paste dyes. For every ounce of dye that is used two ounces of bisulphate of soda should be dissolved and added to the dye bath. The dye is dissolved in boiling water, and enough water is then added to make sufficient liquor to cover the skins, the bisulphate of soda being then added to the solution of dyestuff. The temperature of the dye bath should be about 100 degrees Fahr. The skins are drummed in the warm dye-liquor for one-half hour, or until they are dyed through; they are then washed in warm water and dried out. When dry, the skins are dampened and worked soft. Before the skins are dyed they should

be made as clean and smooth as possible, so that when colored little buffing will be necessary.

Colored chamois leather is used in the manufacture of gloves, also as linings and for other purposes. If the skins have a uniform shade throughout, they may be buffed on an emery wheel after they are dry and soft and improved in appearance, but if they are not of the same color throughout, the buffing gives them a spotted appearance. Only sufficient buffing should be done after coloring to give the skins a nice nap.

Chamois leather may also be colored by treating the skins with a solution of titanium salt previous to the application of the dye. The skins are soaked in a one per cent. solution of soda crystals in the manner that has been described; they are then drummed in a solution of titanium salt (one per cent.), and are then dyed to shade without previous washing.

BLEACHING CHAMOIS SKINS.

Chamois leather is bleached most satisfactorily by immersion first in a solution of permanganate of potash and then in a sulphurous acid bath.

Before the skins are bleached the excess of oil must be removed. For this purpose a bath is prepared consisting of two pounds of potash in twenty-five gallons of warm water; this is sufficient for one hundred and fifty skins. The temperature of the solution should be about 95 degrees Fahr. Six pounds of soda crystals may be used in place of the potash. The skins are drummed in this solution for from one to two hours, then the liquor is run off and a new one prepared like the first; this is run into the drum and the skins are drummed from one to two hours longer. They are then washed in lukewarm water, wrung out dry, staked, and then bleached.

The solution of permanganate of potash is prepared by dissolving one pound of permanganate in five pints of water. Enough of this solution is added to water in a suitable tub or vat to impart to the water a deep violet color. The bath is then warmed up to 105 degrees Fahr., and the skins are placed in it,

one at a time, and are then stirred about in the bath for twenty minutes, at the end of which time they will be found to be thoroughly impregnated with the permanganate solution. They are then taken out of the liquor, rinsed in cold water and next placed in another vat or tub containing a solution of sulphurous acid. The vat should contain water into which gaseous sulphurous acid is either conducted from a steel cylinder, or aqueous sulphurous acid is added until the brown color of the skins has disappeared and the skins are uniformly white. The skins are stirred about in the sulphurous acid bath for fifteen or twenty minutes or until they are white; they are then rinsed in cold water to remove the superfluous sulphurous acid and are then hung up to dry. A soap solution made by dissolving a good quality of white castor oil or olive oil soap is applied to the skins by washing them in it, after which they are dried in the air, staked and pumiced. A wash of starch or pipe clay stirred into cold water is also sometimes used as a finishing process.

Sulphurous acid may be prepared from sodium bisulphite and acid. Dissolve fourteen pounds of sodium bisulphite in fifteen gallons of water. Into another vessel containing two and one-half gallons of water pour six pounds of muriatic acid and mix it well throughout the water. The skins after treatment with permanganate of potash are placed in the solution of sodium bisulphite and the diluted acid is added slowly until the skins are bleached white through and through. They are then removed from the liquor, thoroughly washed, dried and finished.

SHEEPSKIN FLESHERS.

When sheepskins are split out of lime the grains are tanned in bark, sumac and other tans, and finished into skivers; the splits or flesh portions are made into chamois leather and used for linings, gloves, and other well-known purposes. In addition to chamois skins, the splits of sheepskins can be tanned in numerous other ways and used for various purposes where in-

expensive material is required. A number of tanning processes for these goods will be described.

Tanning with Basic Alumina Liquor.—After the skins are split, the fleshers are drenched with lactic acid and pickled in the same manner as unsplit skins; they are then tanned. For white fleshers the following process will be found quite satisfactory: Weigh the splits and put them into a drum with ten gallons of water in which one pound of Glauber's salt and three pounds of common salt have been dissolved, this solution being used for one hundred pounds of pickled splits. Run the splits in this solution twenty minutes, then drain the liquor off. The tanning solution should be prepared the day before it is used. Twelve pounds of sulphate of alumina are dissolved in ten gallons of boiling water. In a clean tub a solution of one and one-half pounds of bicarbonate of soda in a gallon of hot water is prepared. The soda solution is poured very slowly and with constant stirring into the alumina solution, the mixture being then set aside until the next day.

After the skins have been drummed in the Glauber's and common salt solution and the liquor has been drained off, four pounds of salt and eight gallons of lukewarm water are put into the drum, and the skins are drummed fifteen minutes. Half of the alumina and soda liquor is then poured into the drum and the drum is run two or three hours. The skins are then placed over horses to drain until the next day, when they are hung up to dry. When they are dry they are put back into the drum with eight gallons of water and drummed ten minutes. The rest of the alumina and soda solution is then poured into the drum, and after two or three hours' drumming the fleshers are fully tanned, and after draining twenty-four hours are hung up to dry. The goods after drying are kept in a dry condition or ten days or two weeks, and are then ready to be fat-liquored and finished. If they are soft enough for the purpose for which they are to be used no fat-liquor is necessary; but for very soft goods a fat-liquor of sulphonated oil may be used. From four to seven pounds of the soluble oil is used in eight gallons.

of water at 95 degrees Fahr. for one hundred pounds of dry skins. The goods are drummed in this solution one half-hour, then dried, dampened, staked and finished on a very fine emery wheel. The fat-liquor may also be added to the last portion of tan liquor, tanning and fat-liquoring being thus done at once; this saves time. It is also beneficial to the goods to dampen the dry skins and mill them in flour or chalk before staking and finishing.

Tanning with Alum, Salt, Egg-Yolk and Flour.—The process of tanning described for mocha castor glove leather may be applied to sheepskin splits with good results. The acid pickle should be first removed in a drench of sour bran and salt. Any shade of color can be applied to the goods as they absorb dye readily. Finishing on a fine emery wheel gives fine feel and softness to the skins. A tanning process of alum, egg yolk and flour in the following proportions also produces very soft and well tanned splits. For one hundred pounds of the splits a solution is prepared consisting of twelve gallons of water, nine pounds of alum, three pounds of salt and twenty pounds of flour, at a temperature of 90 degrees Fahr., in which the skins are drummed for one-fourth of an hour. Less flour may be used, and for common goods the quantity may be reduced to five or six pounds. At the end of the fifteen minutes eight pounds of yolk of eggs dissolved in warm water are put into the drum, drumming being then continued for one hour. The skins are then hung up to dry. Finishing consists of staking and running on fine emery.

In place of egg yolk sulphonated oil may be dissolved in warm water and given to the splits after they have been drumming in the alum, salt and flour. After the goods are taken from the drum they should be placed in a tub with the remaining liquor for two days before they are dried. And after they are dry they should be kept in a cool, dry room for two weeks before they are finished.

Chrome-tanned Fleshers.—Sheepskin fleshers, drenched and pickled, may be tanned the same as flesh-finished and grain-

finished sheepskins; they can then be colored with alizarine or with aniline dyes or with natural dyestuffs according to the receipts given for unsplit sheepskins. Finishing on a fine emery wheel gives the goods a fine nap and soft feel; and a paste of flour and water added to the fat-liquor increases the fullness of the leather.

A PROCESS FOR SHEEPSKIN FLESHERS.

To be used in the manufacture of gloves, for bindings, etc. The quantities of tanning materials mentioned are sufficient for two dozen fleshers of ordinary size. The fleshers are immersed, stirred about and pounded for about thirty minutes in a fluid prepared as follows: One pound of alum is dissolved in one and one-half gallons of water, which is readily done by boiling. Then in another vessel are mixed one-half pound of flour and one-half pound of oatmeal, or one pound of either alone, with one gill of oil and one and one-half gallons of water, and this mixture is mixed with the alum solution. The tanning materials may be applied to the skins in a drum, and at the end of thirty minutes the skins are taken out of the drum. They are then immersed for thirty minutes, either in a vat, tub or drum, in a fluid mixture composed of one gill of ammonia, one-half of a bar of soap, one half ounce of soda, one-half pound of salt and about two ounces of whiting or ochre, all boiled in one and a half gallons of water. To this solution is added either one pound of flour or one pound of oatmeal mixed in one and one-half gallons of water, and the fleshers are drummed in the mixture for thirty minutes, after which they are dried, worked soft, and finished upon either the grain or the flesh side. The skins dressed in this manner are very soft and pliable, with much elasticity and strength of fiber without roughness.

After the skins have been treated to the first part of the process they may be dried, staked and finished on either or both sides without being subjected to the second part of the process, and when this is done they are of very good quality

and susceptible of taking a very nice finish. Yet it is preferable to use the entire process in dressing the skins, as they are thus given a superior quality and a capacity for a better finish than when only the first part is used, and when finished they bear a close resemblance to castor or mocha glove leather.

In order to get the skins soft and elastic, and at the same time tough and strong, it is necessary that they be handled in such a way in the early processes of the beamhouse as to prevent any loss of substance or strength. The use of sulphide of sodium in removing the wool shortens the time consumed in the preparation of the skins and at the same time helps to make tough and soft leather. A liming of from six to eight days is generally sufficient for heavy skins, and after the liming is completed the drenching should be carefully done. The bran drench produces a very soft skin, as does also lactic acid, the latter article being very simple and safe to use.

The drenching may be done in a drum, about three quarts of acid being used in one hundred gallons of warm water and the skins drummed or milled for not longer than thirty minutes.

VEGETABLE-TANNED SHEEPSKINS.

Hemlock Tannage.—Large quantities of sheepskins are tanned with hemlock bark and applied to various uses, such as linings, trimmings, pocket-books and sundry fancy leather purposes. Hemlock bark makes a good tannage for sheepskins. It fills and plumps them more than any other tanning material; and the skins acquire a good color on which it is easy to apply aniline dye. Hemlock-tanned skins are finished in the natural color of the tan, they are dyed black when black leather is wanted, or colored and finished with a smooth or an embossed grain for fancy leather purposes.

Pickled skins, before they are put into the tanning liquor, should be pressed to remove the natural grease from them. They then require to be drummed in warm salt water to soften and open them, and to separate them as they get stuck together while being pressed. The drumming must be thorough so

that all spots become soft or the skins will not tan evenly. It is not necessary to remove the acid pickle but there should be considerable salt in the tan liquor to keep the skins from spoiling. Two and a half bushels of salt should be added to one thousand gallons of tan liquor.

The most satisfactory way to tan the skins is by suspending them in the liquor, tacking them on wooden frames with galvanized iron or copper nails so as not to stain them. One nail on each butt shank is enough. Two skins on each side of the lathe, with the grain side out, are thus suspended. When the frames are to be filled, they are raised out of the liquor and when filled they are lowered by a windlass into the vat so that the skins are submerged. The tanner must be careful to avoid drawing the grain by using too strong liquors at first. If the liquor is too strong the grains of the skins will draw and crack after being dried out. The liquor for the fresh skins at the beginning of the process should not be over six to eight degrees strength. In this liquor the skins remain from one day until the next; they are then hoisted out by the windlass and carried along to the next liquor which should be some degrees stronger than the first one. The tanning is continued in this way, the skins going into stronger liquor each day until they are tanned, which is usually accomplished in from seven to ten days according to the thickness of the skins. After they are tanned, the skins are hung up and dried. When soft and light-colored skins are wanted, the hemlock bark should be rossed before it is ground to remove the gum and resinous matter that darken the liquor. Steam should not be used to leach the bark as it darkens the liquors; and brass pipes are the only suitable ones to use for conveying the liquor to and from the leaches. For dark skins the bark need not be rossed as the dark color of the liquor is no detriment. However, to get firm, pliable skins of a good color only clean, light-colored bark liquors should be used. The skins can be tanned in paddle vats or in vats without paddles, but these methods do not produce as smooth grains as tanning by suspension. When

tanned, the skins should be horsed up to drain well, then hung in the drying-room to dry. If the skins are to be left in the color of the tan, or if they are to be colored, it is best to dry them in a dark room away from sunlight, but for black leather a light grain is not necessary and such skins can be dried in the open air without injury. Freezing is beneficial to the tanned skins as it makes them softer and of finer texture.

Oak liquors make nice skins for linings and book-binding and fancy leather purposes. A mixture of hemlock and oak bark liquors is a good combination to use, as it produces lighter colored skins than straight hemlock tan. A good tanning process consists of starting the skins in weak hemlock liquor and as soon as the grain is well set to pass them into a stronger liquor, composed of hemlock, oak wood extract and quebracho, care being taken to handle the skins every day under this treatment. A very uniform color is maintained by this process; and the skins are made tough, firm and pliable. Hemlock and quebracho extracts combined form a good tan for sheepskins. The liquors may be two-thirds quebracho and one-third hemlock. The skins tan in a few days. The leather is well filled, soft and of good texture, while the color is light and uniform and more satisfactory than the color of hemlock leather after it is bleached. The tanned skins can be easily colored any shade by the use of aniline dyes.

Quebracho Tannage. — Quebracho extract produces well tanned skins that are easily colored and finished. Either the solid or liquid extract may be used. A quantity of the extract is boiled up with water in a barrel and forms a stock solution from which the tan liquors are prepared and strengthened. The skins are suspended in the liquor in the same manner as in hemlock liquors. The first liquor should be about seven degrees strong, the next liquor a little stronger, and succeeding liquors still stronger until the skins are completely tanned. There must always be salt in the tan liquors or else the salt contained in the skin from the pickle bath would be washed out and the acid remaining would burn the skins.

When the skins are fully tanned, take them from the liquor and hang them up to dry. If the skins are to be very soft a fat-liquor is necessary. This may be given to the skins immediately after they are tanned or not until after they have been colored. It is usually considered best to fat-liquor after coloring, although fat-liquoring after tanning and before drying-out also makes nice leather.

Quebracho extract, alum and salt make a good tanning process. Take for the first bath seven hundred gallons of water in the paddle wheel or vat; add enough quebracho extract to make the strength four degrees barkometer. Then add ten pounds of alum and twenty-five pounds of salt while warm and plunge them until dissolved and mixed. Remove the acid from the skins by a drench of whiting and salt, or one of sour bran and salt, and put them into this liquor. The skins may be suspended in the liquor or a paddle vat may be used. Suspension is undoubtedly the best method. From twenty-four to forty-eight hours are required to strike the skins with the tan material. When they have assumed a light oak color and the grain is well set, the skins are ready for the second bath. This is made by preparing a six-degree quebracho liquor containing salt but no alum. After thirty-six hours, this liquor may be strengthened to ten degrees and the skins left in two days longer, which completes the tanning. The tanned skins should then be rinsed in warm water, struck out and dried, or fat-liquored and then dried. This process makes nice plump skins that can be dyed black, or colored with aniline dyes. Colored and embossed, the skins are fine leather for pocket books and bags, sweat bands for hats, and other special purposes. A combination of one-fourth palmetto extract and three-fourths quebracho produces plump and mellow skins. As both of these extracts are rapid tanners, tanning can be completed in a short time.

Combination Tannage.—For colored sheepskins, a tannage of gambier, salt, alum and sulphate of soda produces plump, firm and smooth-grained leather. The acid used as a pickle

should be removed before the skins are tanned. Use two pounds of bolted whiting and five pounds of salt in fifteen gallons of water at 90 degrees Fahr. for one hundred pounds of pickled skins. Run in drum one-half hour. Let stand one-half hour, then wash the skins in two baths of clean, warm salt water to remove all the whiting. Always use salt in the wash water to hold the skins from swelling. And every trace of whiting should be washed away or the tanned skins will be tender. After the skins have been washed, let them drain a few hours before tanning them.

Tanning may be done in a drum or by suspension. If a drum is used, use six pounds of gambier, two pounds of salt, one and a quarter pounds of alum, one pound of sulphate of soda and one-half ounce picric acid for each dozen skins. Boil the gambier in a tub, the other materials in a pail or tub, and mix the two solutions and use at 100 degrees Fahr. Give the liquor to the skins in portions of a pailful at a time at intervals of five minutes to prevent a coarse, harsh skin. The skins should be drummed in the liquor from one to two hours, then placed over horses to drain until the next day.

If the skins are tanned by the suspension method, add about half of the tanning materials to water in the vat and after a few hours add the rest, and keep the liquor stirred up until the skins are tanned. This method of tanning keeps the grain smooth and makes the skins firm and plump. The treatment that the skins are given after they are tanned depends upon how the skins are to be finished. If dry, colored skins are wanted, they are dried out after tanning, then washed and colored, dried again, worked out and finished. If soft leather is wanted, suitable for coats, gloves, bindings, etc., they should be fat-liquored the next day after tanning, blacked on the grain, dried, staked and finished. Or they can be dried after tanning, then moistened and colored, then fat-liquored and dried for finishing. Nice, dry skins are made by coloring after drying, then working out and finishing without using any fat-liquor at all. Palmetto extract tans sheepskins into nice soft leather

that is easily colored. If a chrome combination tannage is wanted, the skins are tanned with one-bath chrome liquor, then shaved, retanned with gambier or palmetto, struck out, colored and finished.

Sumac Tannage—Sumac makes soft, pliable, light-colored skins that are easily colored and finished into fancy leather. The tanning is done in vats, the skins are then dried and later on moistened and colored.

Sheepskins tanned with any of the processes that have been described work out into soft, pliable leather without being fat-liquored, but if very soft skins are wanted they should be fat-liquored with an emulsion of oil and soap after they have been colored. Taken from the tan liquor, the skins are hung up and dried, then moistened and colored.

Sheepskins for Upholstering Purposes.—An experienced practical tanner gives the following receipt for tanning sheepskins into what is called Spanish Leather for furniture and automobiles. Take the pickled skins and remove the pickle from them by drenching with whiting and salt in the manner that has been described for the combination process. After washing out the whiting, the skins are in condition to be tanned.

Take six pounds of alum, three pounds Glauber salts, four pounds of common salt, dissolve in ten gallons of soft water. Take also five pounds of ground sumac, three pounds of oak bark, one pound of nutgalls and four ounces of sulphuric acid. Add the sumac, oak bark and nutgalls; boil twenty minutes, then strain while it is hot; then pour in the sulphuric acid and stir well. This quantity of liquor will tan one hundred pounds of skins. Use this liquor lukewarm. Drum the skins in it for one hour, then let them drain for twenty four hours. Then oil them with neatsfoot oil on both sides, and hang them in a warm room to dry. If smooth surfaces are required, the skins should be struck out hard on both sides before the oil is applied; and while they are drying, the skins should be worked continually until they are dry and soft. This leather will not absorb moisture; it is used for automobile coats as well as

furniture upholstery. Doubtless it could be used for other purposes also. When the skins are dry and soft, they can be colored. The prevailing shades are dark green, oxblood or wine color, tan and chocolate brown.

METHODS OF COLORING VEGETABLE-TANNED SHEEPSKINS.

Sheepskins that have been tanned with a vegetable tan, such as bark, sumac, quebracho, gambier and other similar tanning materials, are usually dried after tanning. When dry they are packed away and left until they are to be finished. The longer they are kept in the dry or crust condition the softer they are when finished. When the skins are to be colored, they require a moistening and softening in order to remove from them all the dirt, dust and particles of tannin that have not combined with the leather. At the same time washing serves to soften the skins and to put them in the right condition to be colored. Shaving also is done to make the skins of even thickness.

When the washing is properly done, the colors are made clear, full and deep. When dry skins are immersed in dye baths, many defects are noticed in the finished leather. The color cannot penetrate nor combine with the fibers and the results of the coloring process are decidedly unsatisfactory. The dry skins may be moistened in a tub and left in piles for some hours to become uniformly moist and soft, or they may be moistened in a drum. The water used for this work should be soft and warm since such water has greater softening and cleansing powers than cold water. A safe temperature is from 85 to 95 degrees Fahr. The amount of treatment necessary to bring the skins into the required condition depends upon the character and condition of the skins and how they were tanned. Very light and soft skins require very little treatment, but careful handling, while thick and fine skins must be given more thorough preparation.

Before coloring is attempted, the skins should be sorted according to texture and weight. Those that are firm and thick should be colored separately from those that are soft and

open grained. The clear and fine-grained skins should be dyed the lighter shades and those that are dark colored and streaked the darker shades, or dyed black. It is advisable to have a supply of skins tanned and dried ahead as they improve while lying in the dried condition. After the skins have been colored, they should be dried and finished as quickly as possible.

A good way to color the skins is to wash and soften them, then drum them in a warm sumac liquor. This serves to freshen up the skins so that they will readily receive the dye liquor. Usually about four ounces of extract of sumac dissolved in warm water is sufficient for one dozen skins. In this liquor the skins are drummed twenty minutes. Then to clear the grain and to set the dye, two ounces of tartar emetic for each dozen skins, dissolved in hot water, is poured into the drum and the skins are run fifteen minutes longer. After this, it is best to rinse the skins in warm water, drain the drum, and then put the skins back and color them. From two to four ounces of aniline are required by each dozen skins; the temperature of the dye bath being about 100 degrees Fahr. In place of sumac, fustic may be used, if the skins require a mordant. Vegetable tanned skins do not require a mordant as the tannic acid in the tan serves as a mordant; but something to freshen up the leather and to make more uniform colors is necessary.

Titanium potassium oxalate is a valuable material in leather coloring. The titanium unites with the tannin of the leather to form a yellowish-brown titanium tannate, which combines with the fiber of the leather and which is fast and stable and brings up subsequent colors in a remarkable way. The leather in addition to being mordanted is also given the yellow base necessary when all shades except lilac, gray and purple are wanted. After being treated with the titanium salts, the skins are ready to be colored any shade. Both acid and basic dyes color freely, evenly and rapidly on the yellow mordant base resulting from the use of titanium salts. The dry skins are

moistened and softened, then run in a solution of eight ounces of titanium potassium oxalate for every hundred pounds of dry leather. This may be done in a paddle vat or drum, preferably the latter. Drumming the skins in the solution of titanium salts for ten minutes gives the yellow base on which any shade of tan, brown, oxblood, etc., can be easily obtained. The shade of yellow-brown produced varies with the kind of tannin in the leather. Sumac gives the more yellowish shade. Young fustic with titanium salts gives a light tan. Gambier and red fustic with titanium salts produce a brownish tan.

If acid dyes are to be used, the skins can be colored at the end of the ten minutes, without being washed; but if basic dyes are to be applied, after drumming in the titanium solution, the liquor should be run off, the skins washed and then run in the dye liquor until the right shade is obtained; then they are washed again, fat-liquored or not, and hung up to dry. No tartar emetic or bichromate of potash is used with the titanium potassium oxalate. The colors produced by this method of coloring are faster to light, fuller in shade and with less tendency to "grinning" than those obtained by any other process of dyeing. The process is neither expensive nor complicated.

Dyeing the Skins Black.—Excellent results are obtained by the use of logwood and titanium-potassium oxalate. Take the dry skins and soften them with warm water. Then drum them in logwood liquor, slightly alkaline, for twenty minutes. In the meantime dissolve ten ounces of titanium-potassium oxalate in hot water for every hundred pounds of dry skins. At the expiration of the twenty minutes, pour the titanium solution into the drum and drum the skins ten minutes longer; then wash them, fat-liquor, or not, as the skins require, and then finish them. No copperas, iron liquor or other striker is necessary. The titanium-potassium oxalate after logwood strikes a deep, permanent black.

If the black is required to go deeper or right through the leather, drum the skins first in a solution of four or five ounces of titanium-potassium oxalate for one hundred pounds of dry

leather, then add the logwood liquor, and after the skins have been drumming fifteen or twenty minutes in the logwood, pour into the drum four or five ounces of titanium salts for each hundred pounds of dry leather; run the drum ten minutes; then take the skins out, wash and finish them. When titanium-potassium oxalate solution is used to develop the black, there is less tendency of the leather to spew.

If soft, black leather is wanted, the following method of handling the skins may be followed: Take the skins out of the tanning liquor, wash and press them. Then fat-liquor them with oil and soap, and dry them out in the usual manner. When the skins are dry, soften them with warm water, run them in a solution of titanium-potassium oxalate as just described, then in logwood, and then in titanium solution to strike the black; then wash the skins, strike them out and dry them for finishing. The result will be soft, supple leather, dyed through flesh and grain and of a deep, permanent black.

The skins can also, of course, be dyed with logwood and copperas, or bichromate of potash, or iron liquor. Logwood liquor is made by boiling five pounds of logwood crystals and one pound of sal soda in ten gallons of water until dissolved; then run in enough water to make fifty gallons of liquor. A good "striker" is made of fifteen pounds of copperas and five pounds of blue vitriol to fifty gallons of water.

The skins are drummed in the logwood liquor fifteen or twenty minutes, the requisite quantity of copperas solution is then poured into the drum and the skins are drummed fifteen minutes longer, washed and finished. A few ounces of fustic paste boiled with the logwood makes the black deeper and richer.

The methods of dyeing the skins with logwood and titanium salts possess some advantages over dyeing with logwood and copperas, or iron liquor. A better black as to color and better also as to durability is obtained and the leather is more durable and less apt to spew. The logwood liquor should contain some fustic and sal soda if the best possible black is wanted.

Drumming the skins first in a solution of titanium-potassium oxalate, then running in good logwood liquor and drumming the skins fifteen minutes, then adding more titanium solution carries the color through the leather and produces a permanent jet black on the grain. Eight or ten ounces of titanium salts for one hundred pounds of dry leather are sufficient. Half should be used for the preliminary drumming and the rest after the skins have taken up the logwood. Washing after dyeing is important and should never be omitted.

For some purposes the skins work out sufficiently soft without being fat-liquored. If soft skins are required, the fat-liquoring can be done immediately after tanning or after the skins have been colored.

Coloring with Aniline Dyes.—A few practical formulas are given that will enable the dyer to produce several of the shades that are in demand at the present time.

No. 1. Oxblood.—For one hundred pounds of dry skins use eight ounces of titanium-potassium oxalate. Soften the skins with warm water and drum them in the solution of titanium at 95 degrees Fahr. for ten or fifteen minutes to get a suitable base for the dye. Run off the liquor and wash the skins; then put them into the drum and give them the dye. Each dozen skins of average size requires about six ounces of amaranth 3-R and one-eighth of an ounce of malachite green. Boil these dyes in a gallon of water, then add one gallon of water and apply to the skins at 100 degrees Fahr. and run fifteen minutes. Then wash and fat-liquor the skins.

No. 2. Oxblood.—Take ten dozen skins. Moisten with warm water, then run in drum with water at 90 degrees Fahr. to soften and wet them. Dissolve in hot water three pounds of tartar emetic; pour the solution into the drum and run the drum fifteen minutes; then drain the liquor off. To color, use four pounds of amaranth 3-R, given to the skins in four portions. After the first portion is in the drum, run the skins ten minutes, then add the remaining portions of dye at intervals of ten minutes. Then add to the contents of the drum a pound

and a half of amaranth 1-R and eight ounces of chocolate-brown O, and run the drum one-half hour. Drain the water out of the drum, run in the fat-liquor, then add ten ounces of bichromate of potash and drum the skins ten minutes longer, wash them and dry them for finishing.

No. 3. Oxblood.—The correct shade of oxblood can be obtained on vegetable-tanned skins in the following manner: For each 120 feet of dry leather, boil ten pounds of hypernic chips. Strain the liquor. Put the skins into the drum with water at 90 degrees Fahr., add the hypernic solution by degrees while the drum is running, and drum the skins one-half hour. Dissolve by boiling, seven ounces of amaranth 3-R in a gallon of water. Strain the solution through cheesecloth and cool it down to 110 degrees Fahr. by adding cold water. Divide this solution into three parts and apply to the skins at intervals of five minutes, running the drum fifteen minutes after the last of the dye is poured in. Take the skins out and dip them in a barrel of clean, warm water. Run off the waste dye-liquor and wash the drum out. Put clean, warm water sufficient to cover the skins into the drum with the skins. Dissolve three ounces of bichromate of potash in two gallons of hot water and apply to the skins while the drum is running, and run the drum fifteen minutes. The temperature of the liquors should be about 100 degrees Fahr. If the skins are to be fat-liquored, fat-liquor them immediately after coloring, then hang them up to dry.

No. 4. Brown.—For one hundred pounds of dry skins use eight ounces of titanium-potassium oxalate dissolved in warm water. Drum the skins in this solution ten minutes. Then drain the liquor out of the drum, rinse the skins in a barrel of warm water and put them back into the drum. Color with leather-brown F, using one ounce for each large skin and less for smaller skins. Run the skins in the dye one-half hour, wash and finish them.

No. 5. Brown.—A nice shade of brown can be obtained in the following manner: Drum the skins in a solution of titanium salts for ten minutes, then drain the drum and add the color

solution made of four ounces phosphine for leather, one-fourth ounce leather-green M and one-half ounce methyl violet 2 B. Run skins in the dye fifteen minutes, wash and finish them.

No. 6. Red.—One dozen sheepskins tanned with hemlock or some other vegetable tan can be colored a dark red by using four ounces Fulling Red for leather. Drum the skins in the dye liquor twenty minutes, then add one-half ounce bichromate of potash and run the drum ten minutes longer; then wash and finish the skins.

Any shade of tan, green, yellow, brown, etc., can be easily obtained by using the proper aniline on skins prepared with titanium-potassium oxalate. Use eight ounces for one hundred pounds of dry skins. Dissolve it in warm water and drum the skins in the solution for ten minutes. If acid aniline is to be applied, simply drain the liquor out of the drum and put in the dye. Run the skins in the dye, then wash and finish them.

If a basic dye is to be used, after drumming the skins in the solution of titanium-potassium oxalate, run off the liquor and wash the skins; then color them. But if the titanium is all taken up by the skins it is not necessary to wash the leather before applying the dye as both basic and acid dyes color satisfactorily on the titanium mordant. If the dyer is in doubt as to whether he should wash his skins or not, he can always be on the safe side by rinsing them off in a barrel of warm water before he gives them the aniline dye. It is always safe to prepare vegetable-tanned skins by drumming them in sumac liquor for half an hour, then striking them out by hand or machine. The next process is running them in a solution of titanium-potassium oxalate as described; then coloring, washing and finishing. Sumac is always safe to use no matter what color is to be applied afterwards. Skins prepared with sumac and titanium salts take full, rich shades with aniline dyes. Tartar emetic is another good article to use in dyeing the skins. It is applied previous to the aniline to clear the grain and set the dye, the skins being afterward washed and colored. If

sumac is used to freshen up the leather, drum the skins in the sumac liquor, then pour into the drum a solution of two ounces of tartar emetic per dozen skins; run the drum ten or fifteen minutes, then wash them, put them back into the drum and color them with aniline and, when they have been drummed in the dye twenty minutes, wash and finish them.

Treatment for Dark, Greasy Skins.—Skins that are dark, greasy and dirty can be much improved by the use of borax and sulphuric acid previous to coloring. Put them into the drum with warm water containing considerable borax and wash them twenty minutes. Run off the borax bath and put into the drum warm water with sulphuric acid quite strong, and drum the skins in it ten minutes; then rinse them in clean water. Make a sumac bath strong and hot and add a little salt to it. Drum the skins in this bath thirty minutes, then rinse them in clear warm water and strike them out for coloring. Run them in warm titanium solution, then in the dye, rinse, and finish.

Fat-Liquoring.—When very soft leather is wanted, it is necessary to fat-liquor the skins after they have been colored. The surplus water should be pressed out of the skins either by machine or by hand. Heat the drum with steam, drain out the condensed steam, and put the leather in. Run it in the closed drum a few minutes to warm it and open the pores of the skins. Next pour the fat-liquor through the gudgeon, about two gallons at a time at intervals of five minutes, until the fat-liquor is all in, then run the skins in the liquor thirty minutes or until the skins have taken up the grease and nothing but water is left in the drum. Let the skins drain a few hours, then strike them out and hang up to dry.

Whether or not sheep leather should be fat-liquored, and how much fat-liquor to use, depends upon the kind of leather that is being made and upon the degree of softness that is desired. If firm, dry leather is wanted, the skins can be finished without fat-liquor. If soft leather is desired, the skins must be fat-liquored, but not very heavily.

An excellent fat-liquor is made as follows: Put ten pounds of potash soap into a clean barrel with ten gallons of water, and boil and stir it until it is dissolved. Into four gallons of best neatsfoot oil stir four ounces of borax dissolved in a quart of boiling water, taking care to stir thoroughly to cut the oil. Put the oil into the soap solution and stir thoroughly. Then run in enough cold water to make fifty gallons of fat-liquor. The tanner can, if he desires it, add ten pounds of egg yolk to the oil and soap solution, but not until it has been cooled down to 75 degrees Fahr. with cold water.

Seasonings for Colored Skins.—1. A glazed finish is obtained on russet and colored leather by using this dressing. Dissolve four ounces of blood albumen in a gallon of water over night. Cook four ounces of granulated gelatine in a gallon of water and let it cool. Mix half a pint of white varnish shellac with half a pint of ammonia. Mix the three solutions thoroughly together and add enough water to make three gallons. Apply to the skins with a sponge, and glaze when dry. For colored skins use a little less ammonia, and make the finish a week before it is to be used, so that the ammonia will evaporate.

For a plain, natural finish give the skins two coats of finish and roll while wet, then hang them up to dry, and when they are dry give another coat of the dressing.

2. Dissolve one-half ounce of bichromate of potash in a little hot water, and when the solution is cold add it to two gallons of egg albumen solution. Then add a quart of acetic acid and ten gallons of water. Strain and apply to the skins, and while the grain is damp iron or roll, and a good dull finish will be obtained.

2. Boil flaxseed often and for a long time with a little water. Strain the solution before using it, and beat it up the same as white of egg. To a pail of water add one and a half pints of milk, the whites of two eggs well beaten and one-half pint flaxseed also well beaten up. This finish should be put on evenly and without streaks by means of a soft sponge or a sheepskin pad. When the seasoning has been put on, the skins are hung

up to dry and then rolled. Colorless seasonings for glazed or embossed leather can be bought ready for use.

If embossed leather is wanted, the skins should be seasoned and then embossed by the use of an embossing machine. Imitation of seal, monkey, alligator and other skins are made in this way. When the skins have been properly tanned and colored, beautiful effects are produced. There is a large demand for such leather, as it is used in the manufacture of pocket-books, hand-bags, belts, suspenders, and leather specialties and novelties.

Finish for Embossed Sheepskins.—Sheepskins tanned in a vegetable process that are to be grained or embossed can be seasoned with this finish: Two ounces of caseine; two ounces of O shellac; one-half ounce ammonia; one gallon of water. Boil all until dissolved, stirring continually. Let stand over night or until cold. Add one gallon of water and one-half ounce of glycerine, mixing all together. Apply with a sponge, giving an even coat, then dry. The skins are then ready for glassing on the machine. After glassing, they may be grained by arm board and embossed, which is the concluding process.

Finish for Black Embossed Sheepskins.—A nice, lasting finish is obtained by using this dressing on skins that are to be printed, grained, pebbled or embossed. Put into two gallons of water eight ounces of extract of logwood, one ounce of bichromate of potash and two ounces of prussiate of potash, and boil until dissolved; and when the solution is cool, strain it. To each gallon of the above solution add two quarts of beef blood. Blood albumen can be used in place of beef blood if desired. Give the skins an even coat of this dressing and let it dry.

When the skins are ready to be printed or embossed, dampen the grain evenly so that it will take the impression without the grain being cut. Then print, emboss, grain or pebble according to the grain that is wanted.

Embossed or printed leathers have commanded a steadily increasing attention on the part of tanners, with the result that

to-day some wonderful reproductions are made on sheep leather. The first embossed leathers were produced with the ordinary pendulum machine, using a small six-inch steel roll, upon which the desired figure was cut or etched. By this unsatisfactory method results were achieved which were considered truly wonderful until the advent of the later machines, consisting of two rolls arranged one above the other after the manner of the every-day clothes-wringer. The lower roll was of rubber, while the upper, which was interchangeable, was of heavy steel, upon which was electrotyped from the genuine skin a pattern of seal, pig, alligator or lizard, as the case might be. The great advantage of this latter machine was its ability to print an entire sheepskin without showing any joints or laps, as was impossible with the method first in vogue, except in the printing of small figures. In both of these processes the skins could only be embossed while in a certain condition to properly receive the impression, after which they were thoroughly dried before finishing.

Upon its introduction, this method was considered as near perfection as human ingenuity could devise, but it has since been succeeded by still more modern ideas. The latest machine consists of flat steel plates from sixteen to thirty inches square, electrotyped as were the heavy rolls, and used in a knuckle-jointed press built especially for the purpose, with rise and fall sufficient to allow the operators to feed in the skins and get the proper impression. Skins can be embossed by this method in a dry state, owing to the greater pressure that can be exerted in this manner, although a certain amount of heat is used to make the embossing easier and more permanent. Almost any variety of figure can be obtained, but the successful embosser of to-day is obliged to keep in touch with the different fads which the public runs on, and which are apt to change with each varying season.

SKIVERS.

A skiver is the grain side of a split sheepskin. In making

this class of leather, sheepskins are split in the beamhouse, and the flesh or inner portion is made into glove or chamois leather, and the grain portion is tanned in sumac, bark, alum or some other tanning material and used in the manufacture of leather goods, such as pocket-books, belts and suspenders, as linings and trimmings. Skivers are also used in large quantities as hat or sweat bands. As the grains, as skivers are called after the skins are split, are of very light substance and possess very little strength of fiber, they must be handled very carefully during the processes of tanning, coloring and finishing.

The splitting is done after the skins have been limed. On account of the fact that skivers are often finished in light colors, it is important that the liming, drenching and other processes are done in a very cleanly manner in order that the skins may be clean and free from shaded or spotted grain. After the splitting has been done, the grains are drenched to rid them of the lime and to put them into the right condition for pickling and tanning.

A suitable drench is one made of warm water and lactic acid. It is best to make a new drench for each lot of grains. The quantity of acid used is one pint for every hundred pounds of grains. The water should be warmed to 95 degrees Fahr., the acid then added and stirred, and the grains put in. It does not take long to wash out the lime; and the grains are then washed and pickled. They are also tanned without being pickled.

An efficient drench for the limey grains is made of bran in the following manner: One-half of a barrel of bran is mixed with water into a thick mush. The barrel is then covered up and allowed to stand forty-eight hours until it has become thoroughly sour. The sour bran is then emptied into the tub or vat to be used and mixed with enough water to cover the skins. This quantity of bran is sufficient for six hundred grains. To the water and bran should be added three pints of sulphuric acid and three pecks of common salt; and the prepared drench should then be heated to ninety degrees Fahr. The grains are stirred about in this liquor only long enough to

thoroughly cleanse them of the lime. For light colors it is best to wash them before pickling in order to still further cleanse them; but in most cases this is not necessary as the skins are soft and clean and pickling serves to further bleach and cleanse them. Another method of using the bran drench is to allow the fermentation to take place while the grains are in the liquor. The same quantity of bran is used as when it is fermented in a barrel. About one-half of the bran is added to warm water in the paddle vat, and while it is being stirred, half of the skivers are put in; then the balance of the bran is added and next the rest of the skivers. It takes some time for the bran to sour; and as it sours the grains rise to the surface of the drench. They need to be drenched until they are perfectly soft and clean, after which they may be rinsed in warm water and pickled.

A pickling liquor is made by adding two and one-half quarts of sulphuric acid and fifty pounds of salt to one hundred gallons of water. After the grains have been in this liquor thirty minutes, they can be kept a long time before tanning as the pickle preserves them from spoiling. When alum is used as a tanning agent, the grains can be tanned without being pickled.

Skivers can be tanned with any material that is used in tanning sheepskins. Sumac is in common use. Bark tannages and alum and chrome processes are also used. Quermos extract, quebracho and hemlock extracts also make good skiver stock. If white skivers are wanted alum may be used, or the chrome process followed by a bleaching bath. While they are being tanned, the skivers must be handled carefully to prevent tearing. By suspending them in the tan liquor all danger of tearing is prevented and a smoothly colored grain and uniform tannage are assured.

For a common grade of skiver tanning may be done in hemlock liquors. Very little tanning is necessary; getting the grains well struck through is all that is required. Sumac leaves or the extract of sumac may be used. The tanning does not take long, and when it is completed, the skins are rinsed off in water to remove surplus sumac and dried out.

When alum and salt or a chrome process is used, the tanning is done with most safety in a vat with paddles. The liquor strikes quickly through the grain and there is no danger of tearing. If white chrome skivers are wanted, take the tanned grains and put them into a hot bath of borax water for fifteen minutes, then put them into a bath of water and sulphuric acid, and next wash and dry them out. If colored chrome skivers are wanted, wash them from the tan liquor and put them into a bath of warm sumac liquor. A soft white skiver is obtained by taking the skins from the sumac bath and drying them out. The sumac also serves as a mordant for aniline coloring. Coloring may be done in a vat, in tubs or trays, or by brushing the dye on with brushes or sponges. In a tub or vat immerse the skins in sumac or fustic liquor, then add a solution of titanium-potassium oxalate and the grains will assume a yellowish or tan shade, which is a good and permanent color of itself but which also may be used as a base for any aniline color.

Sumac-tanned skivers, after being dried, are moistened and colored. They are folded lengthwise through the center and dipped in the color solution until the shade is obtained. Adding a solution of titanium salts to warm water makes a bath that gives a yellow-brown base on which acid dyes give very nice results. Vegetable-tanned skins, being quite stiff when dry, must be moistened carefully and thoroughly before they are put into the dye liquor or have any dye liquor applied to them.

Skivers are finished in various ways. They are glazed, finished in dull, also glazed and then embossed, or printed into imitations of alligator, seal or pigskin.

As good a process as any that the tanner can use is a mixture of quebracho and hemlock extracts made up of two-thirds quebracho and one-third hemlock. This tan produces a light color that is uniform and clear. The skivers can be colored any shade desired or bleached and finished in the color obtained by bleaching. For most purposes, however, skivers tanned with

this tan require no bleaching as the color produced by the process is sufficiently light and uniform. Skivers are used mostly for linings; and for this use they must be clean and dry and free from all trace of grease. When they are not de-greased before they are tanned, this must be done before they are finished or else they will not be satisfactory.

ROLLER LEATHER.

This leather is made from lambskins tanned with bark. It is used by cotton spinners all over the world. There are only a few tanners who have been successful in making this leather, and those who have, have had all the business they could attend to, finding a ready sale for their entire output.

The qualities that roller leather must have to be satisfactory are level substance, clear and perfect grain that has no scratches, scars or cuts, smooth feel and pliability with a certain amount of firmness. Only the best skins should be selected. The leather must be perfectly smooth on the grain or the cotton thread when it is drawn between the rolls, one of which is covered with leather, will keep breaking. As a light color is essential, only clean, light-colored bark liquors can be used. The natural grease contained in the skins must be removed since the edges of the leather covering the rolls are cemented together before being slipped on to the roll, and if there is grease in the leather, the cement will not hold.

The preliminary tanning is done in weak bark liquor. The skins are then pressed with a hydraulic press in layers between iron plates and sprinkled with sawdust to remove the grease. They are then taken apart and paddled in a weak liquor and drummed in warm salt water until all press-creases have disappeared.

The skins are tanned by suspension since a smoother grain is produced in this manner than with the use of paddle wheels or vats. The liquor is composed of oak bark and extract of increasing strength in which the skins remain two or three weeks, when they are hung up and dried. When dried, they

are stored away until they are to be finished. The longer the skins are kept in the dry condition the better they are when finished.

When the skins are to be finished, they are sorted. Those that are not as perfect as they should be are finished into fancy leather for pocket-books and book-binding. The roller skins are then dampened and shaved. The shaving must be accurate so that the skins will be of even substance. However, the skins do not all have to be reduced to the same thickness as some of the roller manufacturers make three or four different substances.

After shaving, the skins are drummed in a sumac solution, and then they go back to the tan again to receive a stronger liquor. After being rinsed in water and drained, the skins are struck out on the flesh and tacked out to dry. When dry, they are taken off the boards and softened, then trimmed and seasoned with milk and albumen, dried and rolled, perched by hand, and next reseasoned and glazed. The finished skins are then marked with a frame on the flesh side and trimmed with a pair of shears. As every hair must be removed, the skins are wiped over with a cotton-wool pad to find remaining hairs, which are removed very skilfully so as not to break the grain. The skins are then ironed, sorted for substance, and put into grades and sizes. The processes, of course, are not always followed exactly as outlined since those making this leather change them here and there in accordance with the best results obtainable.

Oak bark makes better roller leather than hemlock, since it contains less filling matter and produces lighter-colored skins.

TANNING WOOLSKINS.

Soaking, Washing and Scouring.—Sheepskins that are to be tanned with the wool on should be good, fresh skins. Old, stale skins should be avoided, as the wool is apt to slip, for which there is no remedy. The skins should be trimmed to remove the parts that are of no value, then fleshed and washed

to remove blood and dirt. After the skins have been washed, which is best done in a wash-wheel supplied with running water, they should be run through the burring machine, which removes all the burrs, twigs and manure adhering to the wool.

The next process is scouring, which is done for the purpose of making the wool as clean and white as possible before the skins are tanned. It is much easier to wash the wool clean before tanning than after, since the alum and salt and other tanning materials set the dirt and grease and render them more difficult of removal.

Scouring is done by laying the skins on a sloping table, applying the scouring solution first to the flesh and then to the wool. The scouring liquor may be made of a strong solution of soft soap, to which a little carbonate of ammonia is added; or it may be a solution of soap, soda ash and salt made in the following manner: Add two buckets of soft soap to fifty gallons of water in a vat or tub, then put in one-half pail of soda ash, turn on steam and boil the solution until soap and alkali are dissolved; then add one pailful of salt and enough water to make two hundred gallons of liquor. The salt helps to bleach the wool; it also counteracts the caustic action of the soda ash.

The scouring liquor is first well worked into the skin with the hands or a brush, after which it is poured into, and worked thoroughly throughout, the wool. The skins are next placed in waste scouring liquor, rinsed in warm water, and then scoured again two or three times if they seem to require it. When they are as clean as they can be made, they are rinsed in water until they are free from soap, then wrung out or drained thoroughly, after which they are tanned. A hydro-extractor is useful for removing the water from the skins.

Tanning.—The tanning may be done with a paste of alum, salt and oatmeal. Heat two gallons of water until it is near boiling point, and stir in powdered alum until the taste is very puckery. Add one-half as much salt as alum to the solution; then stir in one pound of rolled oats or oatmeal, and boil the

mixture for a few minutes, and allow it to cool. This tanning paste makes the flesh nice and white. If yellow color is wanted add one pound of gambier to the paste, the gambier having been dissolved separately. The skins are spread on a table, flesh side up, and the paste is spread on evenly, a liberal coat being applied and care being taken to touch all parts alike and to keep the wool clean. The skins are then laid flesh to flesh, or folded half over the other half, and left until the next day. The paste should be applied every day until the skins are tanned. They should then be hung up to dry, and as they begin to dry should be worked with some kind of a staker until soft and dry.

The wet skins can also be tanned by using a mixture of powdered sulphate of alumina and common salt, two parts of the former and two parts of the latter, or a mixture of powdered alum and salt. This dry mixture may be rubbed into the flesh side of the skins every day for several days, when the skins will be fully tanned.

Another way to tan the skins is to dissolve eight ounces of sulphate of alumina and one pound of salt in a gallon of warm water, and applying several coats of the solution.

A convenient way to tan the skins in any of these processes is to stretch them into frames and to apply the paste or dry powder to the flesh side.

The skins can also be tanned with a solution made as follows: Dissolve ten parts sulphate of alumina in a tub of boiling water. In another vessel dissolve two parts washing soda. Add the latter solution slowly and with constant stirring to the former; set the solution aside to cool, and then apply it to the skins.

Alum-tanned skins before drying should be given a solution of soap or stearine, which serves to fix the tannage so that it cannot be removed by washing. Tanning can also be done by immersing the skins in a solution of alum and salt, then drying them out.

Flour is sometimes added to the tanning paste to make the skins softer and whiter.

After the skins are dry and soft it is advisable to rescour them. This should be done on a table in about the same manner as before tanning, a soap solution being used and the skins being then rinsed in water and either bleached or colored.

Bleaching.—A permanent white can only be obtained by bleaching the skins with peroxide of hydrogen. The bleaching bath is prepared as follows: Enough sulphuric acid is added to water in a tub to make a one per cent. solution by weight, or ten pounds of acid to one hundred gallons of water. To this acid solution seven pounds of sodium peroxide are added, the solution being constantly stirred. The liquor is then tested with litmus-paper, and peroxide or acid is added as required until the solution is quite neutral. Four pounds of silicate of soda previously dissolved are then added. The skins are stirred about in this liquor for one hour, then they are taken out, passed through or scoured with a weak solution of sulphuric acid, washed, drained, retanned if necessary, degreased, and dried. When dry, they are softened and run on an emery wheel to clean the flesh, and are then finished. Retanning is done by applying a solution of alum and salt to the flesh side.

Bleaching may also be done with permanganate of potash and sulphurous acid. The skins are washed, and then placed in a solution of permanganate of potash, made by dissolving one and one-tenth pounds of the same in one hundred and twenty gallons of water heated to 95 degrees Fahr. The skins are stirred about in this solution until the wool is a good, rich brown. They are then removed and drained and then placed in a bath of bisulphite of soda, made up of one hundred and twenty gallons of warm water, seven and one-third quarts of bisulphite of soda, and six and five-eighths pounds of hydrochloric acid. In this liquor they are worked until they are sufficiently bleached. The skins are then rinsed, dried, and finished.

Degreasing.—Most of the grease in the skins may be removed by plastering the flesh side with a paste made of whit-

ing and water. The skins are tacked out wet and the paste of whiting is applied. The skins are then placed in a warm room and dried. The grease is absorbed by the whiting. The plaster should be scraped off and another coat applied. The operation is repeated two or three times until the paste dries clean and white. The flesh is then washed clean and a mixture of alum and salt applied to replace the tanning material removed by washing and degreasing.

Some grease may be removed by brushing the skin with benzine or naphtha, then rinsing off with hot sumac liquor.

Degreasing may be done with benzine in the following manner: Have a wooden tray about one foot deep, three feet wide and four feet long, with a rack about an inch thick to cover the bottom to keep the skins off the bottom of the tray. The leather only should lay in the benzine. The lid of the tray should be made to fit in a slot and filled with water to prevent the evaporation of the benzine. The skins are then dried and finished.

Tanning with Gambier.—To tan skins with the wool on with gambier, wash and scour them and then tan them with alum and salt, preferably by rubbing the powder into the flesh side, two applications being applied. The skins are then rinsed off and put into weak gambier liquor. The wool can be colored a light yellow by adding picric acid to the gambier liquor. One pound of picric acid in gambier liquor is enough for fifty average woolskins. The liquor should be rather weak at the start and strengthened until the skins are tanned through. It is said that alum-tanned skins can be colored a light yellow by immersing them in a solution of picric acid previous to tanning. After the skins are scoured and rinsed, put them into a solution of fifteen pails of warm water to which have been added four ounces of picric acid dissolved in half a pailful of water and one tumblerful of sulphuric acid. The skins should be moved backward and forward for fifteen minutes, then rinsed in water finally and tanned with alum and salt.

Chrome-Tanned Woolskins.—Sheepskins with the wool on

can be tanned by a chrome process by being first pickled with sulphuric acid and salt, and tanned with chrome liquor.

The pickle is made by adding seventy-five pounds of salt and three quarts of sulphuric acid to one hundred gallons of water in a paddle vat. The skins, washed, fleshed and scoured, are put into this liquor and left in it a few hours or over night; they are next drained over a horse and then tanned with chrome liquor. Sufficient one-bath chrome liquor is added to water to make a three or four per cent. solution, that is, three or four gallons of concentrated chrome liquor are added to one hundred gallons of water. The skins are put into the liquor and as they absorb the tan more chrome liquor should be added, and the skins left in the liquor until they are fully tanned. Four dozen medium-size shearlings is about the right number to put into one hundred gallons of liquor.

A practical method of tanning is carried out as follows: A tanning bath is prepared by adding fifty pounds of salt and five gallons chrome tan liquor of 25 deg. Baumé scale, to one hundred gallons of soft water. The pickled skins are put into the liquor and paddled for two or three hours; then another portion of five gallons is added, and the skins are left in the liquor over night. The next day another portion of tan liquor is put in, and the skins are stirred about two or three times during the day and left in until the next day, when, if they are light skins, they will be tanned; heavy skins may remain in the liquor twenty-four hours longer.

Twelve packs of skins can be tanned in the bath by adding twenty-five pounds of salt and fifteen gallons of liquor for each pack of skins. After four packs have been tanned one-half pound of carbonate of potash should be dissolved and added to the liquor to neutralize the free acid. After twelve packs of skins have been tanned the liquor should be thrown away and fresh liquor prepared. The pickle liquor also can be used for twelve packs of skins by adding fifty pounds of salt and two quarts of sulphuric acid for each pack. The tanned skins should be drained twenty-four hours, then washed in a wash wheel or

drum with borax water for one-half hour and finally in clear water for fifteen minutes. In the first bath one pound of carbonate of potash may be used for one dozen skins. The skins are then drained and colored, after which the flesh receives a coat of paste, and the skins are dried, and finished.

If the skins are wanted white, they are bleached, given a coat of paste, dried, and finished.

The paste is made by boiling three pounds of olive-oil soap in ten gallons of water, then adding one gallon of neatsfoot oil, boiling and stirring for several minutes. When the mixture has cooled to 90 degrees Fahr., enough flour is added to make a paste just thick enough to spread smoothly. A liberal coat of this is put onto the skins; they are then dried and finished.

A paste of egg yolk, glycerine and flour is also suitable; also any regular chrome fat-liquor.

The flesh may be made perfectly smooth and clean by running on an emery wheel. Tanning can also be done by first pickling the skins with alum and salt and then tanning them in the chrome bath.

Coloring.—Woolskins and shearlings may be colored any shade of color by the use of either basic or acid aniline dyes. When basic dye is used it is advantageous to bleach the skins and then to immerse them in a bath of bleaching powder or chloride of lime made by dissolving eight ounces of the powder in ten gallons of water. In this solution, which is used cold, the skins are allowed to remain over night; they are then rinsed in a weak borax bath, and colored.

If acid dye is to be applied the skins, upon coming from the bath of bleaching powder, should be passed through a solution of sulphuric acid before they are colored. One to two ounces of acid dye is required by each pair of skins, according to size, and an amount of sulphuric acid equal to about half the weight of the dyestuff is added to the dye bath, together with four times that quantity of Glauber's salt. In place of sulphuric acid, formic acid may be used. Alum-tanned skins, after being colored, should be washed, drained, retanned if necessary,

passed through a soap and oil emulsion, dried, and finished. Skins that are to be colored with basic dye should be washed and passed through a solution of tanning material, say two ounces of sumac, hemlock, cutch or quebracho extract, dissolved in water, immersing for half an hour, then washed and colored. One ounce of basic dye is generally sufficient for two skins. To the dye solution one-half ounce acetic acid and four ounces Glauber's salt should be added. The temperature of the dye bath should be from 100 to 110 degrees Fahr. Good, fast shades of color are also produced by immersing the skins in a bath of sumac, hemlock or quebracho for one-half hour, then immersing in a solution of titanium-potassium oxalate and then dyeing with basic dye. Two ounces of the tanning extract and one ounce of the titanium salt are sufficient for two skins. To get a slight gloss on the wool, the skins, after coloring with acid dye, should be passed through a weak solution of soap and oil, then dried and finished. Six gallons of stock soap and oil mixture is made by boiling six pounds of soap and eighteen pounds of oil, and made up to six gallons. One-eighth of a pint of this mixture for two skins is added to ten gallons of hot water, and the skins, flesh to flesh, are passed through the bath, then hung up and dried, softened and finished.

A good shade of tan is obtained by putting the skins, after washing from the tannage, into a sumac bath for one-half hour, two ounces of sumac being used for each pair of skins, next allowing the skins to drain, and then immersing them in a bath of titanium-potassium oxalate, one ounce for two skins. This produces a yellowish brown or tan color. Any shade of color can be obtained upon skins treated as described by using one ounce of basic dye, one-half ounce of acetic acid and four ounces of Glauber's salt for every two skins. If a gloss is not desired the treatment with soap and oil may be omitted, the skins being washed after coloring, dried and finished.

Tanning with Alum, Salt and Hemlock Extract.—Skins tanned in this process and then scoured and passed through a weak solution of sulphuric acid are made a golden-brown color

that is desirable for some purposes. The skins are soaked and scoured before tanning, the same as for alum tanning, special care being taken to get the wool clean. The tanning liquor is made of alum, salt and extract of hemlock bark. After the skins have been in this liquor four hours they are hauled out and put back so that all parts of each skin may be uniformly penetrated by the liquor. The liquor is quite weak at the start, and strengthened each day until the skins are tanned through. Some potash soap should be added to the stronger liquor to help turn the wool and give the skins a velvety feel. The skins should not be crowded in the vat but given plenty of room.

After the skins are well tanned they should be drained and next oiled on the flesh with a good quality of mineral oil applied warm, and then hung up to dry.

When dry the skins are scoured with a solution of strong potash soap and white soda ash. The flesh is first washed off to make it clean, and to wet it so that it will stick to the table. The scouring suds are then thoroughly rubbed into the wool and washed out again, the operation being repeated at least twice and sometimes three times. This scouring darkens the wool. After it is dark enough and rinsed free from suds, a weak solution of sulphuric acid is thrown onto it and spread over the skin until all parts come into contact with it. The sulphuric acid liquor is made by adding enough acid to water to make the water taste sour. The acid solution changes the color of the wool to a light golden brown. The wool is now given a good blowing-out with water from hose and made as clean as possible, and the skins are next hung up to dry. When dry, they are dampened, arm crutched, buffed on the flesh side, and beaten out on the wool side until they are clean and soft and suitable for use.

To wash woolskins before tanning, the use of borax is recommended in the soaks, as it makes the wool softer and cuts some of the grease out, and the scouring can then be done with soft soap and soda ash. It is much more difficult to remove grease and dirt after tanning than before, and the cleaner the skins are

before they are tanned the nicer they will look and feel when dried and finished.

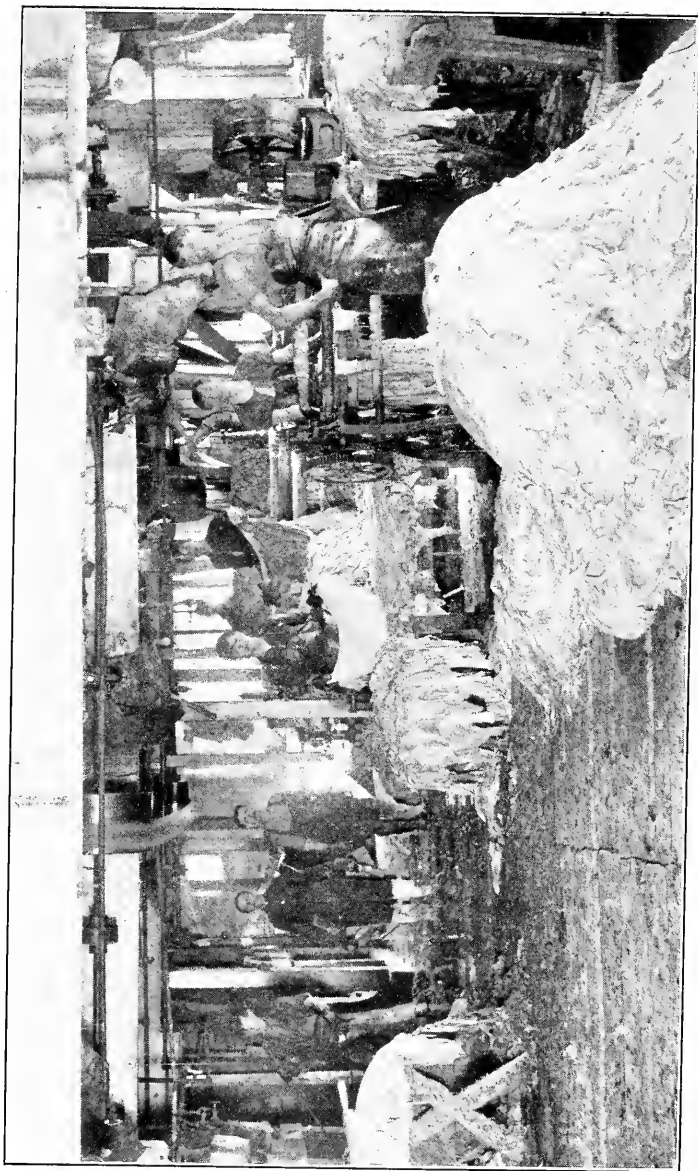
Dyeing Woolskins Black.—After the skins are tanned with alum and salt or with chrome liquor, the wool should be scoured with strong soapsuds so as to remove all the grease, then rinsed off so that no soap is left in it, the skins being then drained an hour or two. Dyeing may be done with logwood, fustic and bichromate of potash. The first bath may consist of one-half pound of bichromate of potash dissolved and added to ten gallons of water, the temperature of the bath being about 100 degrees Fahr. The skins are doubled, flesh side in, and immersed in the solution; then removed and drained. The second bath consists of strong logwood liquor to which some fustic extract and ammonia have been added. One and one-half pounds of logwood crystals, four ounces of extract of fustic and one pint of spirits of ammonia make ten gallons of good liquor. The temperature of this bath should be 120 degrees Fahr., and the skins should remain in it until every part has been colored. They should then be drained and immersed in a stronger bath of bichromate of potash, say one pound of potash in ten gallons of water. After the skins have been passed through the liquor, they should be drained, and the wool should receive an application of kerosene oil, well rubbed in, after which the skins should drain an hour or two, and then be washed, dried and finished. The color should be a good black and permanent.

The dyeing can also be done by putting the skins first into strong logwood and fustic liquor for a few hours, then transferring them to a solution of bichromate of potash, after which, if a sufficiently intense black has not been obtained, they may be again placed in the first bath of logwood which has been strengthened, and then finished off in the bichromate of potash liquor, drained, washed and dried.

Another process of dyeing woolskins black is as follows: For one dozen skins a bath is prepared of eighty gallons of water, twenty pounds of logwood extract, three and one-half

pounds of fustic extract and two pounds of verdigris or copper acetate. This bath is heated to 110 degrees Fahr., and the skins are allowed to remain in it three or four hours, the temperature being maintained during the process. Two and one-half quarts of acetate of iron are then added to the bath, and the skins are left in the liquor and stirred about until they are dyed black, which usually requires an immersion of thirty to forty hours.

The skins, after cooling, are drained and allowed to oxidize at least twelve hours; they are then washed in warm water and scoured with a solution of soft soap and carbonate of ammonia, then washed and drained, and retanned with alum and salt, and stretched in frames to dry. This treatment after dyeing is necessary if a jet black is to result. To obtain more gloss on the wool the skins are passed through a hot, dilute soap and oil solution, then dried and softened.



BEAM ROOM IN A CALFSKIN TANNERY.

SECTION THREE.

THE MANUFACTURE OF CALFSKIN LEATHERS.

IN tanning calfskins for upper leather, the beamhouse work is most important. During the process of soaking the skins are softened and the salt, blood and other objectionable material are removed from them. Clean skins going into the limes have much to do with clear-grained leather. And it is advisable to accomplish the results of soaking in as short a time as possible, and not to carry the soaking beyond a certain point. The soaking of green-salted skins for chrome leather should be done in such a manner as to hold up the bellies and flanks. It is claimed by some experienced tanners that clean hard water is the best for soaking; others prefer soft water. Soaking for a long time results in loose, porous leather, lacking in fullness and plumpness, owing to the loss of gelatine which should remain in the skins.

In order to accomplish clean and thorough soaking, the salted skins should be soaked in clean, fresh water. When they are very dirty or heavily salted, a good practice is to soak them for a few hours in clean water, then to take them out of the vat, and after allowing them to drain until the dirty water is drained off, to again soak them in clean water. Ordinarily no change of water is required if clean water is used. The length of time that the skins should be soaked depends upon their condition and thickness; and no arbitrary rule can be followed. As good a rule as any is to trim the skins and put them into clean cold water for twenty-four hours, next to wash them in a wash mill for fifteen minutes, and then to soak them again for twelve hours, and then to flesh them. It is beneficial to the softening of the skins to add a little dissolved sulphide

of sodium to the water. One pound of the material may be used for each hundred gallons of water. The washing removes dirt and helps to open the skins. It is also good practice to flesh the skins after washing, and then to soak them for twelve hours or longer before liming them.

Borax used in the soaks is beneficial to the skins. By its use the dirt and dried blood are dissolved and the grain is made soft and silky, allowing the lime liquor to readily attack the hair sheaths. From five to eight pounds should be added for each thousand gallons of water. While the salt used upon raw skins acts as a preservative, upon being dissolved in the water it has an injurious effect upon the skins, causing the leather to be soft and lacking in fullness, and, in the case of light-colored leather, to show a clouded and spotted grain. Washing and resoaking remove all the salt before the skins are put into the lime.

Old, stale soaks, in which quantities of blood, dirt and salt have become dissolved, are unpleasant and dangerous to use. The decay which sets in old soaks sometimes affects the skins in such a manner as to impair their quality, although the condition is not always noticed at the time, and later no one can tell what caused it. It is not good practice to put a mixed lot of skins into the soaking process. In other words, the skins should be sorted, and only those of similar nature and size soaked together. This is a good rule to follow in all leather-making processes, the sorting before putting skins through a process assisting greatly in making uniform quality. The skins should be spread out and pushed under the water gently, and when washed and put back the skins that were at the bottom should be on top, and those that were on top should be at the bottom during resoaking. This gives the skins equal chances to absorb water and to be soaked uniformly. Trimming should be done before the skins are put into the water. Another good way to soak salted skins is to wash them for a few minutes, then to put them into the water for twenty-four hours, more or less, according to their thickness and condition.

Dry skins require more thorough soaking in order to get them sufficiently soft to go into the limes. Such skins, when carefully tanned, make good leather, although the grain is more or less damaged by cracks and other imperfections. Sulphide of sodium should be added to the water in which such skins are softened to hasten the soaking and to freshen up the withered grain. For every hundred gallons of water use from four to six ounces of the sulphide; and more can be used with good results. Dissolve the sulphide in hot water, then stir it into the water. Put the dry skins into the water and put boards on top to hold them under the water. When the skins have soaked forty-eight hours and have become pliable, take them out and drum them in a dry mill for a half-hour, then put them back into the water to soak twenty-four hours longer. If they are not perfectly soft at the end of this time, take them out, let them lay in piles over night, then put them into clean, fresh water for twenty-four hours. They are then ready to be trimmed and fleshed, and are then limed. It is not best to put the skins into the lime until they have become soft and clean and as near like fresh skins as it is possible to get them. Both green and dry skins should be drained after soaking to get rid of dirty water before they are limed. They must be kept from heating, as heat results in more or less injury to the skins, which no treatment can remedy or cure.

While skins are being prepared for tanning into chrome leather, it is essential that their substance be kept intact so that the leather will be firm and plump. To soak the skins too long or to use too much lime and bate makes soft, thin and spongy leather. As there are little plumping and filling qualities in chrome processes it is imperative that loss of skin-substance be guarded against, more so for this class of tanning than for any other. Of the various kinds of skins calfskins are the most difficult to tan. This is because they have not attained maturity and full strength of fiber. They require careful handling and are easily injured by carelessness or abuse. The details of the processes must be carefully carried out.

Most of the imperfections of finished calfskins are results of ignorance or mistreatment in some part of the work. To meet with success in the manufacture of calf leather requires skill, judgment and care, and these are acquired only by painstaking application and experience.

METHODS OF LIMING AND BATING CALFSKINS.

The following described liming processes can be depended upon to get the skins into the right condition for chrome tanning.

Liming in Arsenic Limes.—To start with, use a new lime made by taking two pounds of lime for each hundred pounds of skins; have the skins in this lime twenty-four hours. Second day haul the skins out, plunge the lime and put the skins back. Third day take the skins out and add two pounds of lime for each hundred pounds of skins, and put the latter back, spreading each skin out and pushing it down carefully. Fourth day haul the skins out, plunge up the lime, and put the skins back in again. On the fifth day increase the strength of the lime by adding three pounds of lime, well slaked, and one and a half pounds of red arsenic; put the skins back into the liquor. On the sixth day simply haul the skins out, plunge up the lime and put them back. On the seventh day add three pounds of lime and one and a half pounds of red arsenic for each hundred pounds of skins, original weight, and warm the liquor with steam to 75 degrees Fahr. On the eighth day pull the skins out of the lime, warm the liquor to 75 degrees Fahr. and put the skins back. On the ninth day the hair should come off cleanly and easily. After the hair has been removed, wash the skins ten minutes in warm water, then refresh them and work out all the fine hair. After this has been done, the skins should be washed in warm water and then bated. Red arsenic as used in this process keeps the grain from rising and the skins flat. It also produces fine grain on the leather that will glaze more brightly than leather treated with sulphide of sodium. The best way to prepare lime and arsenic is to weigh out the proper

quantity of each, mix the two in a tub, add water and siake and dissolve both together. Better results are obtained when the two articles are mixed together than when they are dissolved separately, and by combining both in proper proportions the hair is loosened so that it can be removed easily, the grain is smooth and fine, and enough skin-substance is dissolved without being depleted too much to produce the necessary softness.

Place the limed skins in warm water containing eight pounds of borax to one thousand gallons of water, and the lime in the grain will be removed to some extent, the grain softened so that the fine hairs and scurf will come out readily when the skins are worked. Lime alone makes the grain rough and harsh. To place limed skins in cold water fixes the lime in the fibers and sets the short hairs so that they can be worked out only with considerable difficulty; therefore warm water containing borax is recommended.

The following method of liming calfskins with lime and red arsenic produces soft, thoroughly limed skins. The quantities of lime and arsenic are for five hundred calfskins.

The lime vat, preferably about six feet deep, is filled with about three feet of old but clean lime liquor, and to this are added two feet of cold water. About one hundred pounds of lime and five pounds of red arsenic are thoroughly slaked together in a tub with ten or twelve pails of hot water, two or three pails of cold water being then added, and the solution of lime and arsenic is poured into the lime vat. The skins are reeled out of the lime every day and drained for about one hour and then put back into the liquor again. On the third day seventy-five pounds of lime are slaked and added to the lime liquor, and the skins are put into the same. In from five to seven days the skins will be in condition to be unhaired.

The strength of the lime should be about 3.5 degrees Twaddle in the beginning, and after it is strengthened on the third day it should be about 6 degrees Twaddle. The lime can be used again and again by being run down and strengthened for each pack of skins in the manner described.

Preparing the Skins with Lime and Sulphide of Sodium.—

For the first day's liming use three pounds of lime and one pound and a half of sulphide of sodium for each hundred pounds of skins. Put the fleshed skins into this lime and leave them in it twenty-four hours. The next day haul the skins out and give them the same quantity of lime and sulphide. On the third day, haul the skins out, plunge the lime and put the skins back. On the fourth day, the lime should be warmed to 80 degrees Fahr. and the skins put in again for twenty-four hours longer; then unhair them. A second pack of skins can be started in the old liquor and left in one day, then, on the second day run off the old liquor and make a new one, using six pounds of lime and three pounds of sulphide of sodium for one hundred pounds of skins. On the third and fourth days handle the skins as directed above. Starting skins in an old lime, then making a new and stronger one makes the hair come readily so that after unhairing has been done on a machine, the skins do not need to be worked for fine hair. After unhairing has been done, wash the skins for fifteen minutes, then bate them.

The old way of liming in vats or pits has been superseded by liming in paddle wheels. The skins need not be hauled out when the lime is to be strengthened if it is not convenient to do so; the lime can be added while the paddle wheel is running. The paddles should not be run all the time. Ten minutes in the morning and again in the afternoon is all that is necessary.

The methods employed by tanners in liming skins vary. Many tanners follow no exact rule but work according to judgment, depending upon it to tell them when the skins are limed enough. When old lime liquor is to be had, a good starting lime may be prepared by using two-thirds old liquor and one-third new, that is, if there are six hundred gallons in the vat four hundred gallons are old liquor and two hundred are new liquor, or simply fresh water. This may be strengthened every day by the addition of new lime and arsenic, or the skins, after being started in the old liquor may be put into stronger lime

until they are sufficiently swollen to enable the workman to readily remove the hair.

When preparing new lime liquor slake one hundred pounds of lime with twelve pails of hot water. Mix seven pounds of red arsenic into the lime before slaking it. Both materials should be completely dissolved before they are used. The quantities of lime and arsenic mentioned are enough for six hundred pounds of skins to start with. After the skins have been in the liquor one day they should be hauled out and the lime stirred up from the bottom of the vat. If the skins are allowed to drain before being put back into the lime, they will take up the lime more readily. When paddle vats are used, hauling out is not necessary, but it is a good plan to keep the lime stirred up from the bottom of the vat. The lime should be strengthened each day with a little fresh lime until the hair becomes loosened; and after the hair is loose the skins should lie in the liquor a day or two longer to further soften them and to make the hair come off easily. Liming may be accomplished in six or seven days. When skins are left two days in an old weak liquor, five days in strong liquor is sufficient to finish the process although the thickness of the skins, time of the year and the temperature and strength of the liquor must be taken into consideration.

Liming is accomplished in less time in summer than in winter. The removal of the hair is done most expeditiously by machine, although hand-work is still employed to some extent.

In this process lime and arsenic are used in much the same manner as in the first process described, but the quantities are a little different. This is a good process for box or grained leather from the larger and heavier skins.

In the first lime use two pounds of lime for each hundred pounds of skins, put the skins in and paddle them twice during the day. The next morning add two pounds of lime as on the first day, run the paddle twenty minutes during the day; and then on the third day pour two pounds of lime and one pound

of red arsenic into the liquor. On the fourth and fifth days add two pounds of lime and one pound of arsenic for each hundred pounds of skins, warming the liquor to 80 degrees Fahr. on the fifth day. On the sixth day give the skins the same quantity of lime but no arsenic; and run the paddle once or twice during the day. Unhair on the seventh day, then fine-hair by hand. Let the skins lie in warm borax water after un-hairing and before fine-hairing. The proper time to remove hair is when the grain has been softened a little in warm water and the skins are still full of lime. After the skins have been fine-haired, they should be washed for fifteen minutes to remove part of the lime. The more they are washed the more lime is removed and the less bating is required.

A new process of liming skins consists of the use of lime, red arsenic, sulphide of sodium and hyposulphite of soda. Although this process is generally used in goatshins there is no reason why it cannot be employed in preparing calfskins, as it makes very fine leather, soft, yet firm in the necks and flanks, and having a beautiful grain that no other process can produce.

Briefly stated, the process is as follows: The skins, after soaking and fleshing, are painted with a thin paste of lime and arsenic and unhaired after twenty-four hours. In a drum the skins are next treated with a solution of sulphide of sodium for twenty-four hours. Without washing, the skins are then placed in a paddle vat and subjected to the action of a solution of hyposulphite of soda for twenty-four hours. After the hyposulphite treatment, the skins are placed in a vat containing lime and arsenic liquor, where they remain from two to five days, after which they are washed, bated or drenched, and treated as skins are usually treated to prepare them for tanning into leather. This process is a patented one. Another process is as follows:

Paint the skins with sulphide of sodium to remove the hair. Then put them into a solution of sulphide either in a drum or vat for twenty-four hours. After this lime the skins for four or five days in clean, fresh limes, then wash, bate and pickle

them. Lime must always be used with sulphide of sodium, as the latter when used alone does not split up the fibers of the skins, and the leather does not carry fat-liquor as it should, and becomes hard after it has been finished awhile.

It is always safe to lime skins more for one-bath chrome tanning than for the two-bath process, since the latter splits up the fibers of the skins, which one-bath liquors fail to do.

The next step in the manufacture of calf leather is the process commonly called bating or drenching. By means of this process the skins are freed from the lime and sulphide used in the previous process, and are made clean and soft to receive the tanning materials. No lime should be left in the skins. Lime in skins becomes changed into sulphate of lime, which closes the pores of the skins and shrinks them, making the grain harsh and rough and the leather close and hard. Bating and drenching serve to remove not only the lime but whatever skin substance may have been dissolved by the lime. During this process, too, the skins lose their hard and swollen condition acquired during the liming process and become thin and soft and receptive to the tanning materials. Five practical and safe bating processes are described.

Bating with Lactic Acid.—Weigh the washed skins. For each hundred pounds of skins use one pint of lactic acid. Run sufficient water into a paddle vat and heat to 95 degrees Fahr. Put the acid into the water and stir thoroughly, then throw in the skins. Run the paddle wheel for two or three hours, then take the skins out, wash and then pickle them.

Bating with a Fermented Lactic Acid Bate.—This process consists of lactic acid and sour grape sugar. It is a simple process and is carried out in the following manner: Take one hundred pounds of grape sugar or glucose and stir them into thirty-five gallons of hot water in a clean barrel. Allow this to stand for two days in a warm temperature, when it will be completely soured. Prepare a paddle vat with water at a temperature of 95 degrees Fahr., and put into it two and one-half quarts of the sour sugar solution. For every hundred pounds of skins to be

treated, take one pint of lactic acid and put about half of it into the prepared bate before throwing in the skins. When the skins are in, add the remainder of the lactic acid slowly. Run the skins in the bate from three to four hours, then take them out and wash them. The importance of this simple washing is too often overlooked and the necessity of it cannot be over-emphasized, if a good clear grain which will color evenly is desired.

For the second pack of skins, the liquor should be run down about twelve inches in the paddle vat and the loss made up with fresh water. The temperature is brought up to 95 degrees Fahr., as for the first pack, two and a half quarts of the sour sugar solution are added, and one pint of lactic acid for every hundred pounds of skins exactly as described for the first pack. Continue in this way, running off a little of the liquor after each pack, for six days, then run off all the liquor but retaining about a barrel full with which to mellow the new liquor, which is prepared with fresh water.

It should be pointed out that the quantity of sour sugar solution, namely, two and a half quarts per pack is based upon the volume of the liquor in the paddle wheel. The average capacity of a paddle wheel is between two thousand and twenty-five hundred pounds of skins. The fermentative action of the sugar is, however, so mild that a wide range in the weight of stock bated with two and a half quarts of the sour solution is permitted without any danger.

This process and the one following have been tested by the writer and found to be perfectly satisfactory where full flanks, good break and fine even grain are desired, as they always are in calfskins, and these processes will be found the best that can be used.

Fermentative Bating with Lactic Acid.—Prepare a paddle wheel with water at a temperature of 120 degrees Fahr., and put into it two pails full of dry bran, and allow it to stand over night. Next day bring the temperature up to 95 degrees Fahr., and take one pint of lactic acid, for every hundred

pounds of skins and put about half of it into the bran liquor. When this has been done, stir or plunge the liquor, then throw in the skins and afterwards slowly add the rest of the acid.

Run the paddle wheel for three to four hours, then take out the skins and wash them in warm water. For the second lot of skins run the bate liquor down about twelve inches and make up the loss with fresh water, warming up to 95 degrees Fahr. as before; do not use any more bran but take one pint of lactic acid for every hundred pounds of skins and proceed as described for the first lot. Continue in this way for six days, after which run off all the bate liquor and make up a fresh liquor with water at 120 degrees Fahr., and two pails of dry bran, allowing the same to stand at least twelve hours and then proceed in the manner described. This is a very good process for calfskins, and with a little practice very uniform results are obtained. As definite quantities of material are designated for each lot of skins it is an easy matter to use this process, and the results are sure to be satisfactory.

Bating with Bran.—This is a reliable formula: Take a half barrel of bran, add enough water to make it mushy, then cover it up and let it stand for forty-eight hours to sour. When it is sour, empty it into a vat half filled with water. Add about one and a half quarts of sulphuric acid and three pecks of common salt, mix together, and heat to 95 degrees Fahr. This quantity of bating material is enough for three hundred and fifty to four hundred skins. Throw the skins into the vat and run the paddle for four or five hours, then wash them in warm water if for black leather, or work them over the beam and then wash them, if for colored leather. This process produces soft and clean skins which can be easily pickled and tanned in any tanning process.

Bating with Manure.—The use of the excrement of dogs and birds cannot be recommended as they are decidedly unpleasant materials to handle and call for considerable care and judgment in their use; nevertheless many tanners employ them, claiming to get finer grained leather than by the use of any

other process. A practical method of deliming calfskins with dung is here described. Chicken excrement is the material used. The manure should be put to soak in warm water for three or four days before it is to be used. One hundred average skins require a bushel of the soaked manure. Put the material into the water in the paddle vat, stir thoroughly and heat to 85 degrees Fahr. Throw the skins into the liquor and run the paddles one hour, then at intervals of one hour run the paddle a half hour at a time until the skins are sufficiently bated. When the skins are "low" and soft and apparently free from lime, take them out of the liquor and wash them in warm water for five minutes and, after allowing to drain thirty minutes pickle them.

Sometimes it is convenient to bate the skins during the night. Warm the liquor up to 85 degrees Fahr., and throw in the skins. Run the paddle one hour, then let the skins rest in the liquor during the night. In the morning warm the liquor up to 90 degrees Fahr., run the paddle wheel one hour; the skins should then be ready to be taken out, washed and pickled. The man in charge of the work must use his judgment in determining how much bate to use and when the skins have been bated enough. As soon as they are bated they should be taken out, washed and pickled. The bate wheel should be so constructed that the liquor can be warmed while the skins are in it, by means of a steam pipe surrounded by a wooden box with holes in it; and after the skins are in the vat should be covered with a door the full width of the vat so as to retain the heat. Manure should be strained before it is used to get rid of foreign matter that might scratch the grain of the skins. It is also wise to wash the bated skins in a weak lactic acid bath before rinsing and pickling them. Or the skins may be washed in warm water containing a little boracic acid to arrest putrefaction and to neutralize any lime remaining in the skins. Bating with manure and then washing as suggested makes the skins very soft and clean and the grain smooth and mellow. Pigeon manure is considered the best bacterial bating material

to use, but, owing to the limited supply, chicken manure is commonly used. Chicken manure to which some dog manure has been added is also used. The material should be gathered fresh and dried for future use.

Of the processes of bating that have been described, the writer considers No. 2 and 3 the best, and the manure next. The former are clean and safe and not at all unpleasant to use. There are also manufactured bates on the market that the tanner can buy. They are said to produce the results of manure without its unpleasant features.

PICKLING.

The next process to which the skins are subjected is pickling. This is done in a paddle vat. Sufficient water is run in and thirty-five pounds of salt for each hundred gallons of water are dissolved in it. Then for each hundred pounds of skins, weighed, after bating, washing and draining, ten pounds of salt and one and one-half pounds of sulphuric acid are added before the skins are put in. The paddle should be run while the skins are being thrown in and kept running for two hours, then the skins should be taken out and placed smoothly on horses and allowed to drain for twelve hours or longer before they are tanned. Pickled skins can be kept an indefinite length of time without moulding or spoiling. And pickling also opens up the pores of the skins and puts them into the right condition to be tanned at the same time bleaching and cleansing them.

Pickling can be done in a drum by using one pound of sulphuric acid and fifteen pounds of salt in fifteen gallons of water for one hundred pounds of skins. Run the skins in this solution one hour, then place them smoothly over a horse to press and drain for twenty-four hours before tanning them.

PROCESS OF CHROME TANNING.

No. 1. One-Bath.—For this process of chrome tanning, which is the safest and most economical one that can be used, the skins are weighed and thrown into a tanning drum. For every

hundred pounds of skins use eight pounds of salt and ten gallons of water. Put the salt and water, either separately or in solution, into the drum with the skins, and run the drum ten minutes. While this is being done, dissolve eleven pounds of concentrated chrome tanning material in ten gallons of warm water; and when the ten minutes are up, pour one-third of the solution into the drum with the salt water and skins and run the drum thirty minutes; pour in another third of the liquor and drum the skins one hour; then add the rest of the liquor to the contents of the drum and run the drum four or five hours longer. Then dissolve one-half pound of bicarbonate of soda in a little water, pour this into the drum and run the drum an hour longer. Add enough water to the liquor in the drum to cover the skins and leave them in until the next morning, then let them drain smoothly over horses for twenty-four hours, and finally wash them.

No. 2. One-Bath with Sulphate of Alumina and Sal Soda.—For every hundred pounds of pickled skins dissolve by boiling in five gallons of water four pounds of sulphate of alumina; in another tub dissolve by boiling in five gallons of water four pounds of sal soda. When both solutions have been made, pour the soda solution slowly and with constant stirring into the alumina solution, allowing intervals for the effervescence to subside. Add cold water to cool the resulting white liquor down to 80 degrees Fahr., or set it aside for several hours to cool. Throw the skins into the drum together with eight pounds of salt and five gallons of water for each hundred pounds of skins, and run the drum ten minutes; then pour in the alumina-soda liquor and drum the skins forty minutes. One-bath chrome material is then poured into the drum and the skins are drummed in the combined liquors for four or five hours. Then for each hundred pounds of skins in the drum dissolve and add one-half of a pound of salts of tartar, and run the drum one-half hour. It is good practice to let the skins remain in the drum over night, adding water until the liquor completely covers them; then remove them from the drum, place them over horses to drain twenty-four hours, and finally wash them.

The process can also be used in this way: Drum the skins in salt water for ten minutes, then add the sulphate of alumina and salt, and at the end of forty minutes drumming, drain the liquor out of the drum, add a few pounds of salt and a few gallons of water and then the tanning liquor in portions of one-third at a time, running the drum until the skins are completely tanned. Fully tanned chrome leather will stand boiling. Cut a piece from one of the thickest skins, put it in water in a pail and turn on steam and boil it. If the leather curls it is not tanned. If it remains soft and flat it is tanned; and the skins can be washed and colored with the assurance that they are tanned. Soft water should always be used in one-bath chrome tanning. If the water is naturally hard, it should be softened before it is used. If the skins become warm in the drum it does no harm. Some tanners warm their liquor before using it but there is no special advantage in doing it.

No. 3. Two-Bath Tanning.—If this system of tanning is to be used, proceed as follows: Weigh the pickled skins. For every hundred pounds of skins dissolve five pounds of salt in twelve gallons of water and drum the skins in the solution five minutes. The first or chrome bath consists of five pounds of bichromate of potash boiled until dissolved in four gallons of water; to this solution add four pounds of muriatic acid, these quantities being for one hundred pounds of skins. Pour the liquor into the drum and run the drum from three to five hours, depending upon how thick the skins are.

When the skins are a deep yellow color clear through, take them out of the drum and place them over horses to drain several hours. The workman who handles the skins must wear rubber gloves as the liquor is poisonous and will make the hands sore.

The second bath should consist of eighteen pounds of hyposulphite of soda for every hundred pounds of skins, boiled in eight gallons of water until dissolved and cooled down by the addition of seven gallons of cold water. Into a pail nearly full of water, pour and stir six pounds of muriatic acid. Put the

skins into the drum with the solution of hyposulphite of soda, close the drum and start it. As soon as it is started, pour the acid solution through the gudgeon into the drum and run the skins in the liquor four hours after the acid was put in. The drum should never be stopped until the skins have been drummed in the liquor at least one hour, or the skins will be seriously injured. The funnel and pipe connected with the drum should be made of lead.

In the second bath the color of the skins changes from yellow to blue. Unless they are blue through the thickest part of the heaviest skin, they are not fully tanned and must be run longer in the liquor. When they are blue clear through they are tanned and should then be taken out of the drum, horsed up a few hours and then washed.

Any one of these three processes can be depended upon to tan the skins satisfactorily.

HOW TO COLOR CHROME-TANNED CALFSKINS.

Chrome-tanned calfskins are easily colored any shade with aniline and alizarine dyes, provided they are properly prepared to receive the dye and the right materials and methods are used in the coloring operations. There are numerous methods used by leather dyers in their work. The methods and processes of course, vary according to the experiences that have taught each dyer the method that seems to be the best for his particular requirements.

The common method of preparing this class of leather for the reception of aniline dyes is by the use of some vegetable tanning or coloring material which gives up tannin to serve as a mordant. Sumac, hemlock, palmetto, fustic, and peachwood extracts are the materials that give the best results; and they are therefore in common use. Gambier also is an excellent material with which to mordant chrome leather for aniline coloring. Alizarine dyes are applied directly to the skins, no mordant being necessary. Before any attempt at coloring the skins is made, however, it is very essential that they be thor-

oroughly washed and neutralized in order to rid them of all acids and salts acquired during the process of tanning. This washing must be very thorough. And after the skins have been washed, and before they are colored, it is necessary to shave them and make them of nearly uniform thickness, and smooth and clean upon the flesh side. During the time that the skins are being washed and shaved they must be kept from grease and stain which are readily taken up by them at this stage of the work and interfere with the subsequent coloring and finishing.

When the skins have drained over horses some hours after tanning, they are ready to be washed. The most common way to wash them is by using borax in the first water in which they are washed, then washing the borax away with clear water. A wash wheel supplied with running water, that has plugs to make it tight is used to wash the skins in. For the first washing use one pound of borax and fifteen gallons of warm water. Dissolve the borax in a pail of hot water and add it to the water. Put the skins and water into the wash wheel and wash the skins for thirty minutes; then take out the plugs and turn on running water and wash the skins forty minutes longer. The leather is then ready to be struck out or pressed and shaved.

Very good results have been obtained by washing the skins with sodium phosphate. Use two and a half pounds of it for each hundred pounds of leather, with water at a temperature of 80 degrees Fahr., and wash the leather thirty minutes; then allow the liquor to run off, run in fresh water containing a little bicarbonate of soda and wash the leather twenty minutes. The skins should be free from all trace of acid and salt at the end of the washing process. Where a "twister" is available it should be used as it accomplishes more in a stated time than any other form of washing apparatus.

When the skins are not full of acid simply washing them in hot water is sufficient. The temperature of the water should be 120 degrees Fahr., and there should be two changes of

water. Chrome leather will stand any amount of washing without detriment.

It is always best to shave the skins before coloring them. After they are shaved, put them on a table in a well-lighted room and sort them. Only those with good, clear grain should be colored; those having discolored and broken grain should be dyed black.

Gambier and Fustic Mordant.—For each hundred pounds of skins to be colored use :

Gambier.....	2 pounds.
Extract of Fustic.....	1 pound.

Boil these materials in four gallons of water until they are dissolved; then add eight gallons of water. Put the skins and liquor into the color drum and run the drum thirty or forty minutes; then dissolve in hot water and pour into the drum

Titanium Potassium Oxalate	4 ounces
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for each hundred pounds of skins, and run the drum ten minutes longer. If the skins have taken up the mordant, the liquor can be run off and either basic or acid aniline dye solution run in without washing the leather. If the liquor does not seem to be fully exhausted, it is advisable to run it off and wash the skins before applying a basic dye. For acid dyes washing is unnecessary. Titanium salts, used as directed in this and the following receipts, forms with the tannin an excellent yellow bottom on which all shades of brown, tan, oxblood, yellow, etc., can be obtained in a most satisfactory manner. At the end of the ten minutes, the liquor should be drained out of the drum, the drum started and the solution of dye poured in, the skins drummed at least twenty minutes, then rinsed off and fat-liquored.

Gambier Mordant.—Use two and a half pounds of gambier for each hundred pounds of skins. Dissolve it by boiling in four or five gallons of water, then add enough cold water to make twelve gallons of liquor. Use the same as the gambier and fustic liquor.

Quermos Extract Mordant.—For one hundred pounds of

skins use two and a half pounds of this material, and enough water to make twelve gallons of liquor, and apply it to the skins in the same manner that gambier and fustic are applied. This is an excellent mordant for any shade of color.

Sumac Mordant.—Use one pound of the extract of sumac for each dozen skins. Small skins can be mordanted with less sumac according to their size. The extract is mixed into water at a temperature of 110 degrees Fahr., and the skins are drummed in the liquor twenty minutes. A solution of titanium salts is then poured into the drum and the drum is run ten minutes longer, when the liquor is drained off and the aniline liquor run in.

Palmetto Mordant.—Chrome-tanned calfskins may be prepared for aniline coloring by the use of palmetto extract. This material neutralizes any acid in the skins and makes the grain smooth and firm and in good condition to receive the dye. A practical method of using the extract is to apply it to the skins in a drum. The liquor may be made of one pint of the extract and a little glycerine for one hundred pounds of leather. The skins should be drummed in the liquor thirty minutes; then to the liquor, without stopping the drum should be added four ounces of titanium-potassium oxalate dissolved in hot water and the drum run ten minutes longer. The liquor is then drained off and the skins are ready to be colored.

Fustic Mordant.—The extract of fustic is another excellent article to use as a mordant, either alone or combined with logwood or gambier. Young fustic alone followed by titanium salts gives a light tan. Gambier and red fustic alone followed by titanium salts produce a brownish tan shade. From five to twelve ounces of liquid extract of fustic for each dozen skins according to their size may be used for either light or dark shades. For very dark shades, such as chocolate brown, it may be used in equal proportions with pure logwood liquor. The skins should be drummed in the liquor at a temperature of 110 degrees Fahr. for twenty minutes; then a solution of titanium-potassium oxalate should be run in, the drum run ten

minutes longer, the liquor then drained off, and the dye liquor run in.

Clearing the Grain and Setting the Color with Tartar Emetic.—When tanning material is used to prepare chrome leather for aniline dyes it is advisable to use some material that will overcome any tannin not combined with the leather, to clear the grain and to fasten the dye evenly and permanently upon the leather. Tartar emetic does this perfectly. After the skins have been drummed in the tan liquor the required length of time a solution of tartar emetic is poured into the drum and the skins are drummed twenty minutes longer. Four ounces for each dozen skins is sufficient. At the end of the time stated, the liquor should be run out of the drum, the skins rinsed and then colored. When titanium salts are used it is not necessary to use tartar emetic; and when tartar emetic is used it is not necessary to use titanium salts or bichromate of potash to set the color. The writer personally prefers the use of titanium salts.

OSBLOOD SHADES.

Receipt No. 1.—For each hundred pounds of skins use

Hypermic Extract.....	2¼ pounds.
Logwood Crystals.....	1½ ounces.
Leather Red	½ ounce.

Dissolve these material by boiling in a few gallons of water, then add enough cold water to make twelve gallons of liquor and use it at a temperature of 130 degrees Fahr. Drum the skins in this liquor one-half hour, then dissolve in hot water, for each hundred pounds of skins,

Titanium-Potassium Oxalate 4½ ounces,

and pour into the drum and let the drum rotate fifteen minutes longer. Then remove the skins from the drum, wash and fat-liquor them.

Another way to use this process is to put the skins and twelve gallons of hot water into the drum, start the drum and then add the dyestuffs through the hollow axle. The formula

given above produces a nice shade of oxblood at less cost than aniline colors, and the color is rich and fast.

Receipt No. 2. Oxblood Shade.—Prepare the skins with gambier and fustic, or with sumac and titanium-potassium oxalate, then apply the following dyes:

Amaranth 3-R	2 pounds.
Amaranth 1-R	12 ounces.
Chocolate Brown O.....	4 ounces.

These quantities are for five dozen small skins. Divide the amaranth 3-R into four portions, and drum the skins ten minutes after each portion is put into the drum. Then add the other two dyes and drum the leather one-half hour, then drain and fat-liquor it.

Receipt No. 3. Dark Oxblood Shade.—For one dozen small calfskins use as a mordant

Peachwood Extract	2 pounds.
Fustic Extract.....	1 pound.

Dissolve these extracts in boiling water and use at 110 degrees Fahr. Drum the skins one-half hour, then add the solution of titanium-potassium oxalate and drum ten minutes longer. Then dissolve by boiling the following anilines:

Amaranth 3-R.....	6 ounces.
Malachite Green	$\frac{1}{8}$ ounce.

When the ten minutes are up, drain the liquor out of the drum and run in the dye, using two or three gallons of water for each dozen skins.

Receipt No. 4. Oxblood Shade.—For one dozen large calfskins use as a mordant

Peachwood Extract	$2\frac{1}{2}$ pounds.
Fustic Extract	1 pound.

Dissolve by boiling and apply to the skins at 110 degrees Fahr. Run one-half hour. In the meantime dissolve by boiling in a clean pail

Amaranth 3-R.....	12 ounces.
Glycerine	8 ounces.

Strain the solution, add three gallons of water and add the liquor to the skins at 110 degrees Fahr. Drum the skins one-

half hour, then dip each skin separately in clean water, run off the dye liquor and wash out the drum. Put the skins back into the drum and run them in a solution of two ounces of bichromate of potash per dozen for fifteen minutes. The skins should then be taken out, struck out and fat-liquored. This gives the correct shade of oxblood. A greater depth of color can be obtained by increasing the strength of the peachwood and fustic liquor. For a light shade use more fustic and less peachwood extract.

If sumac extract be used for a mordant, take one pound for each dozen skins, then proceed to color as directed above. Or work according to the following instructions: Mordant the skins with sumac extract, then add a hot solution of titanium salts and drum the leather ten minutes. Then drain the liquor out of the drum and give the skins the amaranth and glycerine solution as described above, drumming the leather in the dye thirty minutes; then wash it, strike it out and fat-liquor it.

ALIZARINE BROWN ON CHROME CALFSKINS.

Receipt No. 5.—No tannin mordant is required. For each hundred pounds of skins use

Alizarine Leather Brown B No 9052	12 ounces.
Extract of Yellow Fustic.....	1 quart.

Heat six gallons of water to 190 degrees Fahr. and dissolve in it the alizarine dye, then add six gallons of cold water and use the liquor at a temperature of 165 degrees Fahr. Put the skins into the drum and start the drum; then pour the liquor through the funnel and gudgeon and drum the skins one-half hour. In the meantime dissolve the extract of fustic in a gallon of hot water, run it into the drum and drum the skins fifteen minutes. Then drain off the spent dye liquor and fat-liquor the leather.

CHOCOLATE BROWNS WITH DYEWOODS AND ANILINE DYES.

Receipt No. 6.—A dark chocolate brown can be obtained on chrome calfskins by using the following dyes in the quantities stated:

Fustic Extract, lemon shade	2 $\frac{1}{4}$ pounds.
Hypermic Extract.	10 ounces.
Logwood Crystals.....	3 ounces.

These quantities are sufficient for one hundred pounds of shaved skins. Dissolve by boiling in a few gallons of water, add enough cold water to make twelve gallons of liquor. Use at 130 degrees Fahr. Put the skins into the drum and run the dye liquor in through the hollow axle; then run the drum thirty minutes. When the time is nearly up dissolve in hot water:

Titanium-Potassium Oxalate	5 ounces.
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Pour the solution into the drum at the end of thirty minutes, and run the drum ten minutes longer. The leather should then be washed and fat-liquored.

Receipt No. 7.—Mordant the skins with either gambier and fustic or palmetto extract. Drum them thirty minutes, then add the solution of titanium salts and run the drum ten minutes longer. Chocolate brown 270 is the proper dye to use. According to their size from four to twelve ounces are required for one dozen skins. Run them in the dye liquor thirty minutes, then wash, and give them the fat-liquor.

Receipt No. 8.—Upon skins mordanted with fustic, sumac or gambier and titanium salts use:

Yellow 849	$\frac{1}{2}$ pound.
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Run the skins in this solution ten minutes; then dissolve and pour into the drum:

Chocolate Brown 270	1 pound,
Bismarck Brown Y S	$\frac{1}{2}$ pound,
Chocolate Brown O	$\frac{1}{2}$ pound,

and run the drum twenty minutes, then wash and fat-liquor the skins.

Receipt No. 9.—A good shade of brown can be obtained in the following manner: For each dozen skins use ten ounces of liquid of fustic or sumac dissolved in hot water. Drum the skins in this liquor fifteen minutes, then pour into the drum four ounces per dozen of tartar emetic also dissolved in hot water, and continue the drumming fifteen minutes, after which

rinse the skins in warm water and color them in the drum with these dyes:

Phosphine for Leather	8 ounces.
Leather Green M	$\frac{1}{2}$ ounce.
Methyl Violet 2 B.	1 ounce.

The anilines must be thoroughly dissolved and mixed before they are used.

In place of tartar emetic, titanium salts may be used. The skins, after they have assumed the color desired should be washed, struck out and fat-liquored.

LIGHT AND DARK TAN SHADES.

Receipt No. 10.—For light tan shade, use for each hundred pounds of skins:

Yellow Fustic Extract	2 pounds.
Titanium-Potassium Oxalate.....	4 ounces.

Have twelve gallons of fustic liquor and use it at 130 degrees Fahr. Drum the skins in it for one-half hour; then pour into the drum the titanium salts dissolved in hot water and run the drum fifteen minutes. The skins should then be washed and fat-liquored.

Receipt. No. 11. Dark Tan.—Dissolve in boiling water for each hundred pounds of skins:

Red Fustic Extract.....	4 pounds.
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Apply to the skins at 130 degrees Fahr., running the drum one-half hour; then add, in solution,

Titanium-Potassium Oxalate.....	6 ounces,
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and run the drum fifteen minutes longer. Wash and fat-liquor the leather. No aniline dye is used to produce these two shades of tan, the fustic extract and titanium salts serving to color the skins the right shade at much less cost than aniline dyes.

HOW TO DISSOLVE ANILINE DYES.

Put the dye into hot or boiling water and boil until it is dissolved; then strain the solution through cheese cloth into another vessel and add cold water until there is twelve gallons

of liquor. A safe temperature is 130 degrees Fahr. It is best not to let the temperature of the liquor in the drum fall below 100 degrees Fahr. The drum should not be stopped until the dye liquor has been in at least ten minutes; and while the dye is being poured into the drum the latter should be kept in motion. These points carefully observed help materially in getting satisfactory colors. The drum and pails used should be kept as clean as possible.

PROCESS OF COLORING AFTER FAT-LIQUORING.

Very uniform results are obtained in the coloring of chrome calfskins by coloring them after they have been fat-liquored. After the skins have been washed and shaved, mordant them with gambier or palmetto extract or with gambier and fustic; then fat-liquor them with acid fat-liquor or with any good emulsion of soap and oil, but preferably with the acid fat-liquor; then color with aniline dyes and dry them for finishing. This method of coloring is preferred by some dyers to the method of fat-liquoring after coloring. The work can also be done by fat-liquoring the skins first, then applying the vegetable tanning-material and then coloring to shade with aniline dye. Skins handled this way can be treated with titanium salts in the same manner as skins that are colored before they are fat-liquored.

HOW TO DYE CHROME-TANNED CALFSKINS BLACK.

Dyeing with Logwood and Titanium Salts.—After the skins have been shaved, they are dyed. Weigh them; and for each hundred pounds use logwood and fustic as follows:

Logwood Crystals.....	1½ pounds.
Fustic Paste.....	4 ounces.

Boil the logwood in ten gallons of water, then put in the the fustic paste and a few ounces of borax and stir the liquor thoroughly. Add enough cold water to make fifteen gallons; use at 125 degrees Fahr. Drum the skins in the dye one-half hour; then add, in hot solution, to the logwood liquor,

Titanium-Potassium Oxalate	6 ounces.
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Run the drum twenty minutes, then wash the leather and prepare it for the fat-liquor. No copperas or iron liquor is necessary, the skins coming out of this process a rich, jet black.

Dyeing with Logwood and Bichromate of Potash.—For one hundred pounds of skins use:

Logwood Crystals.....	1½ pounds.
Fustic Paste.....	4 ounces.

Dissolve the logwood by boiling in ten gallons of water. Dissolve the fustic in a pail of hot water, add it to the logwood liquor, stirring thoroughly. Add water to make fifteen gallons of liquor and drum the skins in it at 125 degrees Fahr. for one-half hour. In the meantime dissolve in a gallon of hot water for one hundred pounds of skins:

Bichromate of Potash.....	1 ounce.
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At the end of the first thirty minutes, pour this solution into the drum and process the skins fifteen minutes longer. Then drain the drum and wash the skins in two or three changes of water before fat-liquoring them. Add to the logwood liquor three ounces of salts of tartar for one hundred pounds of skins.

Dyeing with Logwood and Copperas.—Use for each hundred pounds of skins:

Logwood Crystals.....	1½ pounds.
Fustic Paste	4 ounces.

Boil the same as in preceding receipts and drum the skins in the liquor one-half hour. Add four ounces of borax or salts of tartar before using the dye, prepared by boiling in a pail of water:

Copperas	2 ounces.
Bluestone	½ ounce.

Add enough cold water to make five gallons of liquor. Pour it into the drum and run the same fifteen minutes, then drain the drum, and wash the skins in two or three changes of water to remove all the copperas; then fat-liquor them.

Dyeing with Aniline Black.—Drum the skins in a solution of gambier, sumac, palmetto or fustic the same as for colors.

Then dye with methyl violet aniline, and fat liquor them. Then run in aniline black solution, six ounces per one hundred pounds, for twenty minutes, and then pour into the drum four ounces of titanium-potassium oxalate and run the drum fifteen minutes. Wash the leather, oil the grain and hang up to dry. Use one pound of the titanium salts in a barrel of seasoning, omitting copperas.

FAT-LIQUORS FOR BLACK AND COLORED CHROME-TANNED CALFSKINS.

In order that chrome-tanned skins may be finished into soft and well nourished leather, it is necessary that they be treated with soap and oil in the form of an emulsion after they have been colored and washed. To a great extent the quality of the finished leather depends upon how this work is done and what materials are employed. Nothing can be used that will effect the color or cause the leather to be greasy, streaked, or spotted. After the coloring operations are completed, the skins should be washed and struck out or pressed to remove the surplus water. A suitable pin mill or drum is then heated with live steam to 140 degrees Fahr., the condensed steam drained out, and the leather thrown into the drum. The latter is then set in motion and the leather drummed for a few minutes to warm it. The hot fat-liquor is then poured into the drum through the funnel attached to the hollow gudgeon; and after the last of it is in, the drum should be run thirty or forty minutes so that all the grease can be taken up by the leather leaving nothing but water in the drum. Some tanners in order to expedite matters, do not wash their leather after coloring. They simply drain off the spent dye liquor, and then run in the fat-liquor. Fat-liquor emulsions should be used hot at a temperature of from 120 to 160 degrees Fahr. The less water there is in the leather the more quickly the fat-liquor is taken up.

Any one of the following formulas can be used with perfect safety on black or colored skins.

No. 1.—For one hundred pounds of leather use :

Fig or Olive Soap.....	1 pound.
Neatsfoot Oil	2 pounds.
Moellon Degras	2 pounds.
Caustic Soda	1 ounce.

Boil the soap in a few gallons of water until dissolved, then add the oil, and boil the soap and oil for fifteen minutes; then stir the moellon degreas thoroughly into the emulsion, adding the caustic soda dissolved in water. Stir the mixture very thoroughly for several minutes. Add enough water to make twelve gallons of fat-liquor. Use at 125 degrees Fahr., and run the leather in it for thirty minutes. This is a good fat-liquor for bright-finished leather.

No. 2.—This is a good fat-liquor for colored leather. For one-hundred pounds of skins use :

Soap	$\frac{1}{2}$ pound.
Olive Oil	2 pounds.
Treated Cod Oil	2 pounds.
Birch Oil	2 ounces.
Salts of Tartar	3 ounces.

Boil the soap until it is dissolved, then add the olive and cod oils, and boil for twenty minutes; add the birch oil and then the salts of tartar dissolved in a little water. Run in water to make twelve gallons of fat-liquor, and use it at 125 degrees Fahr. Drum the leather in it for thirty minutes, then place it over horses to press and drain several hours before striking it out and hanging it up to dry.

No. 3.—For light calfskins colored or black, this fat-liquor is recommended :

Palermo Fig Soap	10 pounds.
Neatsfoot or Cod Oil.....	4 gallons.
Egg Yolk.....	10 pounds.
Common Salt	2 pounds.

Put the soap into a clean barrel with several gallons of water. Boil with steam until it is dissolved. Now take the oil and cut it by stirring into it a few ounces of potash or sal soda dissolved in hot water. Stir the oil into the soap solution, then run in forty gallons of cold water to cool the emulsion. Then add

the egg yolk and salt; stir the whole again and apply to the skins at a temperature of 80 degrees Fahr.

The quantity to be used must be determined by the judgment of the operator. Twenty gallons is sufficient for ten dozen small, light skins. It gives excellent results on skins for upper leather and glove stock. Care must be taken to cool off the soap and oil emulsion before adding the egg yolk in order to prevent coagulation of the albuminous constituents of the egg. For use on heavy calfskins, add five or six pounds of French degreas to the oil and soap, mixing thoroughly, and reduce the quantity of egg yolk to five pounds.

No. 4.—An excellent fat-liquor for chrome calfskins is made of the following ingredients:

Palermo Fig Soap.....	20 pounds.
Wyandotte Tanners' Soda.....	5 pounds.
French Degras	100 pounds.

Boil the soap in twenty gallons of water until it is dissolved, then run in enough cold water to reduce the temperature to 140 degrees Fahr. Then add the soda and degreas and stir the mixture vigorously for five minutes, but do not boil it after putting in the degreas and soda. For one hundred pounds of leather use two gallons of this fat-liquor with six gallons of hot water. Use at 125 degrees Fahr. After running the leather for thirty minutes, take it out, rinse in a tub of warm water, set out and oil the grain.

No. 5.—This fat-liquor is suitable for dull or mat-finished calfskins. For one hundred pounds of skins use:

Palermo Fig or other good Soap	1 pound.
Treated Cod Oil	4 pounds.
Moellon Degras	2 pounds.
Caustic Soda	1 ounce.

Boil the soap, add the oil and boil again, then add the degreas and soda and stir five minutes. Use at 125 degrees Fahr. and drum the skins in it for one-half hour.

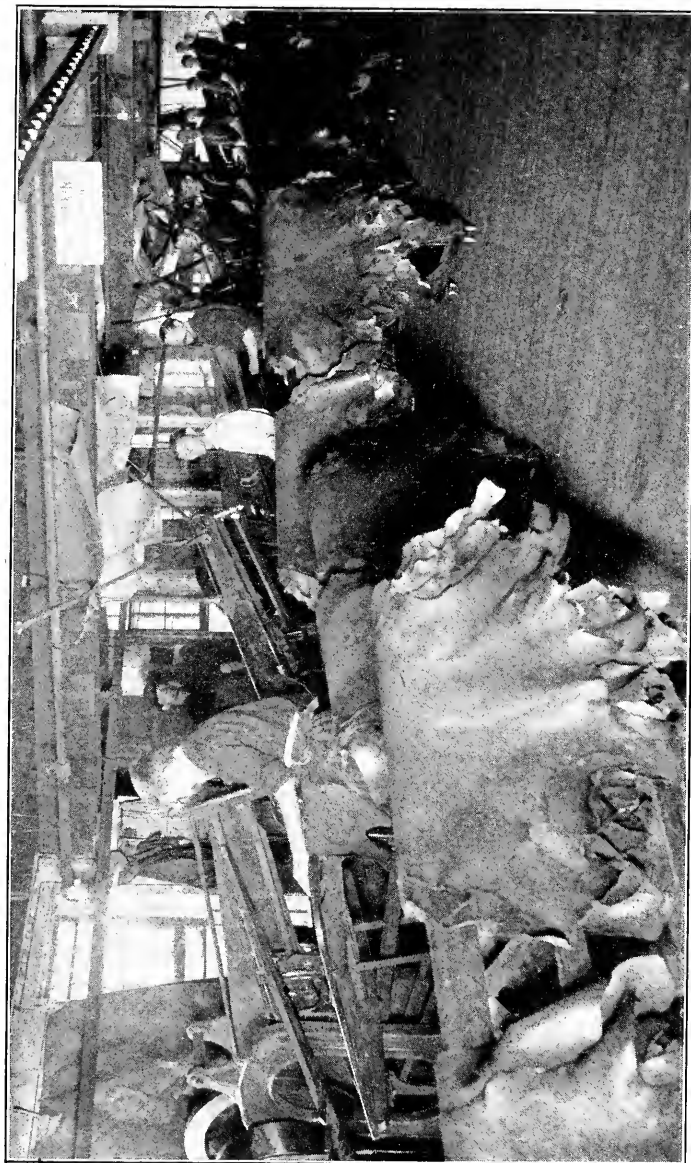
No. 6.—Sulphated oil or acid fat-liquor is a splendid material for chrome leather. From five to five and a half pounds are sufficient for one hundred pounds of leather. Use it by dis-

solving it in warm water and applying to the skins at 95 degrees Fahr. Have the skins thoroughly warmed up before giving them the fat-liquor, and the drum also warm so that the oil will not congeal. Run the skins in the liquor thirty minutes, then take them out and rinse them off in clean warm water to remove all traces of grease. Be sure to have a clean warm drum, warm skins and warm fat-liquor. The grain needs no subsequent oiling when acid fat-liquor is used.

OILING AND DRYING THE LEATHER.

When the fat-liquoring has been accomplished, the skins should be placed smoothly over horses for several hours so that the grease may combine with the fibers. The skins should then be struck out upon the grain and be given a light coat of warm oil. The striking-out is done to smooth out the wrinkles, to work the leather out as much as possible and to lay the grain down smooth and flat. The oil that is applied is the basis of the subsequent finish and should be of good quality, free from tendency to gum or spew. The water should be pressed out of the leather before the oil is put on so that the latter can quickly penetrate into the body of the skin, where it will add strength to the fibers. For glazed and bright boarded finish a mixture of one part neatsfoot oil and three parts paraffine oil is recommended; for dull leather the mixture may be equal parts neatsfoot and paraffine. Olive oil is also recommended for glazed leather. A mixture of one part olive oil and three parts paraffine is quite satisfactory. Sperm oil, treated neatsfoot and Dull Morocco Dressing Oil are all good. It is advisable to warm the oil before use, to apply it evenly over the body of each skin and to rub it into the grain and not to apply any of it to the flanks. After the skins have been oiled they are hung up to dry. It is best to dry them rather slowly in a moderately warm room with good circulation of warm air.

The next treatment is dampening and staking, which should not be done until the leather is perfectly dry.



STAKING CHROME-TANNED CALFSKIN IN AN UPPER LEATHER TANNERY.

DAMPENING AND STAKING.

To dampen the leather, have a tub two-thirds full of hot water. Take a few skins at a time and put them in the water, allowing them to soak a few minutes, then place them in a pile on the floor or put them in a box, press them down hard and cover the pile with damp sawdust. Let the skins remain in the box over night; then stake them. The skins should not be staked too hard, the flanks especially being staked lightly. When the skins have been sufficiently worked out on the staking machine, tack them out smooth on the tacking boards or frames to dry. They soon dry, and should then be trimmed and given a coat of seasoning. For glazed finish stake after trimming.

GLAZED FINISH.

Give the skins a coat of seasoning, hang them up to dry, then glaze them. Next give them a second coat of seasoning, dry and stake; then glaze them the second time. Oil the glazed finish lightly with hot finishing oil or with a mixture of equal parts of neatsfoot and finishing oils and the leather is done. The leather can be handled this way also: After the first glazing, stake the skins, then apply the second coat of seasoning, dry and glaze. Good glazing liquors or seasoning can be bought ready-made. Unless the tanner has a first-class receipt for a seasoning he should buy such material instead of using a finish that may not prove satisfactory.

To clear the grain of grease, rub into it, before applying the first coat of seasoning, a dilute solution of lactic acid, rubbing it in well. When this has dried, apply the seasoning. Or clean the grain before the leather is staked.

BOARDED OR BOX FINISH.

The leather for boarded grain should be glazed and the grain pressed. To obtain a sharp and regular grain it is best to press the leather before boarding or graining it. A powerful press and sharp cut rolls are required; then the skins are

boarded first from head to tail, then from side to side. They are then oiled the same as smooth finish.

SMOOTH DULL FINISH.

Take the skins from the tacking frames and trim them; next apply a coat of dull finish to the grain and dry it; then give another coat of finish and dry; finally iron with a hot iron, then stake them. Finished this way the leather is soft and full, having a fine break and feel.

Seasoning for Dull Finish.—This will make a fine dull finish with a soft, dry feel:

Ivory Soap	1 pound.
Neatsfoot Oil	1 pint.
Whole Flaxseed	$\frac{1}{2}$ pound.
Beeswax	3 ounces.
Nigrosine Black	3 ounces.
Powdered Aloes	1 ounce.
Wood Alcohol	$\frac{1}{2}$ pint.

Boil the soap, oil, flaxseed and beeswax for one-half hour in two gallons of water. Cool and strain. Then dissolve the nigrosine in a quart of water and add it to the solution. Then dissolve the aloes in the wood alcohol and add the solution to the finish. Stir thoroughly.

Seasoning for Glazed Finish.—A good finish for glazed calfskins is made of:

Whole Flaxseed.....	2 ounces.
Logwood Crystals.....	2 ounces.
Nigrosine Black	2 ounces.
Bichromate of Potash	$\frac{1}{2}$ ounce.
Vinette	$\frac{1}{2}$ pint.
Beef Blood.....	1 quart.
Glycerine	$\frac{1}{2}$ pint.
Crystal Carbolic Acid.....	1 ounce.

Boil the flaxseed one-half hour in a gallon of water and strain. Then add the logwood, nigrosine and bichromate of potash. When the mixture has cooled to 90 degrees Fahr., add the vinette, blood, glycerine and carbolic acid. Stir the finish very thoroughly. There should be two gallons of seasoning. If there is less add enough cold water to bring the quantity up to two gallons.

Gun Metal Finish.—To get this popular finish, take the skins after trimming and give them a coat of bright finish, dry and glaze and then stake them. Next apply a coat of the following finish, dry the skins, iron them, then oil the grain with hot oil:

Gum Tragacanth.....	1 ounce.
Yellow Dye	$\frac{1}{2}$ ounce.
Glazed Seasoning.....	1 gallon.

Soak the gum tragacanth twenty-four hours in two quarts of water; then stir it until completely dissolved. Dissolve the yellow dye in a quart of water. Take one gallon of the seasoning for glazed finish and stir into it a quart of the gum solution. Then add the solution of yellow dye a little at a time, stirring thoroughly, until the color of the finish has changed from black to greenish-black. Too much yellow dye must be guarded against or the leather will be too green. For oiling off after finishing, use a hot mixture of equal parts paraffine and neats-foot oils or any good finishing oil.

Seasoning for Chrome Colored Calfskins.—When the skins are trimmed apply a coat of seasoning, dry and finish. Make the seasoning of:

Ivory Soap.....	1 $\frac{1}{2}$ pounds.
French Gelatine	3 ounces.
Blood Albumen	3 ounces.

Soak the soap in six quarts of water for twenty-four hours, or shave and boil it until it is dissolved. Dissolve the gelatine in a quart of hot water. When cool, mix and stir the soap and gelatine together. Soak the blood albumen over night in two quarts of water at 90 degrees Fahr. In the morning stir into it the soap. Strain a quart of the finish into six quarts of water, at 90 degrees Fahr. After giving the leather a coat of this seasoning, dry it and stake it lightly, then give a second coat and hang up to dry. When the leather is half dry, roll it; then dry it and jack it lightly, using a piece of hard felt in place of the glass. The pressure must be light or the leather will show shaded spots.

CALFSKIN GLOVE AND MITTEN LEATHER.

The skins should be sorted right at the beginning so as to get the different sizes and weights into separate lots. Large, thin skins are the most profitable for glove and mitten leather. Soak green salted skins in clean cold water twenty-four hours, then run them in a drum fifteen minutes, put them back into water and soak them eighteen hours longer. The next work is trimming and fleshing, after which the skins are ready to be put into lime. The skins should be well opened out when they are put into the lime and should not be crowded in the liquor but have plenty of room.

For the first lime use two and a half pounds of lime for every hundred pounds of skins. Have it well slaked and plunged up in the vat. Leave the skins in the first lime twenty-four hours, then pull them out, plunge the lime up and put the skins back. On the third day, pull the skins out and add two and a half pounds of lime, well slaked, and return the skins to the vat. On the fourth day, pull the skins out, plunge the lime, and put the skins back. On the fifth day add to the lime in the vat three and a half pounds of lime and two pounds of red arsenic for each hundred pounds of skins and leave the skins in until the seventh day, at which time add three pounds of lime and one and a half pounds of red arsenic and warm the lime liquor to 75 degrees Fahr. On the eighth day take the skins out, warm the lime to 80 degrees Fahr. and put the skins back in again. Nine days lining is sufficient. On the ninth day the skins should be unhaired, washed a few minutes in cold water, then refleshed and worked for fine hair, after which they are bated.

The following described process of bating is recommended for calfskins. It is cheap, simple, safe and effective. Run water into a paddle vat and heat it to 120 degrees Fahr. Put two pailsful of dry bran into the warm water and let stand until the next morning. Then heat the mixture up to 95 degrees Fahr., add one-half pint of lactic acid for each hundred pounds of skins, stir thoroughly and put the skins in. After the skins

are in, add another half-pint of lactic acid for each hundred pounds of skins and run the paddle wheel for three and a half hours; then take the skins out and wash them in warm water. They will be found in excellent condition, soft and clean and free from lime.

For the next lot of skins run out about twelve inches of the liquor and replace it with water; do not use any more bran but use one pint of lactic acid for each hundred pounds of skins and bate the skins exactly as the first lot was bated. After using the old liquor for a week, run it out and make up a new one with two pails of bran and a pint of lactic acid for each hundred pounds of skins to be bated.

The skins, washed from the bate, are then pickled. Make up a brine in a paddle vat by adding thirty-five pounds of salt for each hundred gallons of water in the vat, then add ten pounds of salt and one and one-half pounds of sulphuric acid to the brine for each hundred pounds of washed and drained skins. Plunge the pickling liquor thoroughly, then throw in the skins and run the paddle for two hours so that the liquor will be stirred during the process. When the two hours are up, take the skins out and horse them up nice and smooth for twelve hours; then tan them.

The two-bath chrome-system of tanning is carried out as follows: Weigh the pickled skins. In four gallons of water dissolve by boiling five pounds of bichromate of potash for each hundred pounds of skins in the lot, then add six gallons of cold water and one pound of sulphuric acid to the chrome solution. Put half of this liquor into the drum with the skins and start the drum. As soon as the drum has been started pour the rest of the yellow liquor through the gudgeon and drum the skins in it for three and a half hours, then take them out and place them smoothly over horses and leave them for twenty-four hours. The workman who handles the skins must wear rubber gloves or his hands will become sore from the action of the poisonous chrome liquor. Prepare the second part of the process by boiling eighteen pounds of hyposulphite of soda for

each hundred pounds of skins, in ten gallons of water, and cool the solution down by adding six gallons of cold water to it. Put four pounds of muriatic acid into a pail of water. Throw the skins into the drum with the hyposulphite solution and start the drum. As soon as the drum starts pour the solution of muriatic acid slowly into it through the funnel attached to the hollow axle. Drum the skins without stopping four hours after the acid is put in, then take them out of the drum and horse them up to drain over night. The next process is washing which should be done first in warm borax water and then in clear water until the skins are free from all acid and salt. The one-bath process of tanning can also be used. The manufacturers of the tanning material furnish directions for its use and by following the instructions any tanner can make good chrome leather with perfect safety.

A good way to treat the skins is to tan them with one-bath tanning material, then, without washing them, to color, fat-liquor and dry them, then staking them and washing them for two hours before drying them again for the final finishing. When the two-bath process is used it is best to wash the skins before coloring them, then to trim and shave them.

Light and dark shades of tan are popular colors for gloves and mittens. By following the directions given below very nice colors can be obtained.

Light Tan.—Weigh the shaved skins. Dissolve two pounds of yellow fustic extract in a pail of hot water. Put the skins into the drum with twelve gallons of water at 130 degrees Fahr. for each hundred pounds of skins. Start the drum and then pour the fustic liquor through the hollow gudgeon into the drum; drum the skins in the liquor one-half hour. While the drum is running, dissolve four ounces of titanium-potassium oxalate in hot water; at the end of the half hour add this solution to the contents of the drum and run the drum fifteen minutes longer; then wash the skins and fat-liquor them.

Dark Tan.—For each hundred pounds of skins dissolve four pounds of red fustic extract. Put the skins into the drum with

twelve gallons of water at 130 degrees Fahr., start the drum, then run the fustic liquor in upon the skins. At the end of thirty minutes add to the liquor in the drum six ounces of titanium potassium oxalate in solution, run the drum fifteen minutes longer; then wash and fat-liquor the skins.

Light Yellow.—Make a gambier liquor by boiling twelve pounds of gambier in twenty-two gallons of water; when the gambier is dissolved add to the solution one-half pint of muriate of tin and one and a half ounces of tin crystals. When this liquor has cooled down to 90 degrees Fahr., it is ready for use. For from one hundred to one hundred and fifty skins, according to size, use four pails of this gambier liquor and two gallons of water. Drum the skins in this mixture for one hour, then add one-half pound of picric acid, and one-half pound of fustic extract dissolved in three gallons of hot water, and let the drum run thirty minutes longer; then place the skins over horses, and let them drain until the next morning, and finally fat-liquor them. The foregoing process is a good one to use on skins tanned in a one-bath process. Do not wash them after tanning nor after coloring; but after they have been dried out wash them for two hours, then dry again, stake and finish. The color will be very uniform and permanent, and the leather very soft.

Make the fat-liquor of fig soap, sod and neatsfoot oils and degreas. Boil ten pounds of the soap in fifteen gallons of water. Pour into the dissolved soap three gallons of neatsfoot oil and one gallon of sod oil, and boil and stir oil and soap together, then stir into the boiling liquor seven pounds of degreas and add enough water to make fifty gallons of fat-liquor. The exact quantity to use must be determined by the size of the skins. One hundred large skins require from fifteen to twenty gallons, applied at a temperature of 125 degrees Fahr. Dry the skins in a hot room, and when they are dry keep them in a dry room for a week, then dampen and wash them if they were not washed after tanning, dry them again and then stake them once or twice to get them soft and well worked out.

After the skins have been staked, throw them into a drum with three to four quarts of soapstone for each hundred skins and run the drum two hours. Finally stake the skins again and they are finished; and if the work has been carefully done the leather will be all that could be desired as regards softness and color.

A nice yellow shade can be obtained on the skins by the use of fustic and auramine II. For one hundred pounds of leather dissolve twenty-six ounces of extract of fustic in five gallons of water; add to this solution five ounces of tin crystals and when dissolved add enough water to make ten gallons of liquor. Drum the skins in this yellow liquor one-half hour. In four gallons of boiling water dissolve a little more than five ounces of the auramine dye and run the solution into the drum on the fustic bottom, and let the drum rotate twenty minutes longer, drain the leather a few hours and then fat-liquor it.

CHROME WAX CALF LEATHER.

The tanner of chrome calfskins finds among his skins many that are imperfect on the grain. Such skins can be retanned and finished into chrome wax. Heavy skins are more suitable for this leather than light ones, the latter being more suitable for ooze leather. All skins from a medium up to ten or twelve pounds can be worked into chrome wax, provided they are free from butcher cuts on the flesh side. The skins are worked through the beamhouse the same as those for chrome leather; they are tanned preferably with one-bath chrome material and then shaved. After they are shaved they are washed and then retanned.

Retanning.—This consists in retanning the skins with hemlock extract or with a mixture of hemlock and oak extracts or with any other suitable vegetable tanning material. Two methods of retanning will be here described.

The first liquor is a 5-degree barkometer hemlock liquor in which the skins are hung twenty-four hours. This liquor is then strengthened to 8 degrees and the skins are left in the same

forty-eight hours, after which it is strengthened to 10 degrees, the skins remaining therein forty-eight hours. The skins are then transferred to a 14-degree liquor where they remain six days. Handle every two days or give them a 16-degree liquor for four days, and handle every two days, then they should be given five days in an 18-degree liquor, being handled every other day. The retanning is then completed. The liquors may also be made up of oak and hemlock extracts in the proportion of three parts of the latter to one part of the former.

Retanning may also be done in a drum in the following manner: The first liquor is made of three pounds of hemlock extract and one pound of oak extract and five pounds of salt in twenty-five gallons of water for one hundred pounds of skins, weighed after tanning in the chrome liquor. In this liquor the skins are run one hour, then they are piled down for twenty-four hours. The second liquor may be the same as the first, the skins being run in it one hour, then piled down for twenty-four hours. On the third day the skins are given the last retanning liquor, which is made up of three pounds of oak extract and one pound of hemlock extract and no salt. The skins are run in this liquor two hours, then placed in piles for twelve hours. Retanning by suspension in the liquor is doubtless the better method of the two. In handling the skins through the tan yard it is well to take them from the vats and allow them to lie in a pile from four to six hours. After they are fully retanned, they should lie on a pile forty-eight hours and then be fat-liquored.

Fat-Liquoring.—The fat-liquor is made of sop and degreas. For every dozen skins in the lot eight ounces of good soap are boiled in ten gallons of water; when dissolved, four pounds of moellon degreas are stirred in. This liquor is given to the skins at a temperature of 125 degrees Fahr., the skins being run in it forty minutes, then left in a pile over night. The next day they are pressed, hung up and dried slightly for the second fat-liquoring.

The second fat-liquor consists of stearine, hard grease and cod oil. The workman must depend upon his judgment to tell him when the skins are in suitable condition for the stuffing. The necks and flanks should be dampened more than the rest of the skins so that they will not absorb too much grease and be made coarse. The quantity of grease to be used must also be decided by the judgment of the operator. Chrome wax will not carry as much grease at vegetable-tanned leather. The stuffing should be used at a temperature of 140 degrees Fahr.

After the skins are taken from the drum they should be placed in a pile and covered up and left until the next day. They are then set out on the flesh side with a slicker, and then with a stone, and hung up by the hind shanks until partly dry; they are then reset on the grain side. When the skins are dry, they are piled down nice and smooth for six days when they are ready for whitening. It is best to whiten by hand. After the skins are whitened they are grained with a heavy cork board going from right back shank to left front shank and *vice versa*. They should be thoroughly softened before they are blacked.

Blacking.—A good black is made as follows: Take eight gallons of water and dissolve in it one and one-half pounds of logwood crystals, then add one-half ounce of bichromate of potash and stir well. Next add five pounds of good tallow soap and one-half pound of caustic potash and boil for two hours, then add five pounds of good gas lampblack and boil for three hours. There should be twenty gallons when finished. This soap black should be stirred fifteen minutes every three hours until it is entirely cold, when it is ready to be used. The blacking can be put on by machine and better results are obtained by giving the skins one coat and glossing them; then give another coat and gloss again. After the second glossing the skins are ready for the paste.

Paste.—Mix two and a half pounds of flour with water until it forms a thin batter. Start by using a small amount of water

so as to get all the lumps worked out; keep adding water until there is a thin batter. Now add to the batter one-half pound of soap cut into small pieces and one-fourth pound of frozen glue that has previously been soaked over night in a quart of cold water, two ounces of black nigrosine and one pint of cod oil. Boil this mixture half an hour and allow it to cool over night. In the morning add sufficient water to make it thin enough to feed through the machine. Give the skins a light coat of this paste and hang them up until almost dry, then take them down and gloss on the glossing jack and hang up over night, as it is very important that the paste be absolutely dry before the finish is put on.

Finish.—The finish is made as follows: Soak one pound of frozen glue in three quarts of cold water twenty-four hours, then add to the soaked glue one-half pound of ivory soap, two ounces of beeswax cut into small pieces, one and one-half pounds of white tallow, four ounces of black nigrosine, and boil the mixture twenty minutes and allow it to stand twenty-four hours undisturbed. Now add very carefully fourteen quarts of cold water, adding the same slowly and stirring all the time. When all the water is mixed in the finish is ready for use. This finish will give the skins a fine, mellow feel, and should be put on by hand, using a sponge. The skins should be given a good coat and hung up to dry. When thoroughly dry they are ready to trim and measure. The finished leather is very fine and soft.

VEGETABLE TANNAGES FOR CALFSKIN UPPER LEATHER.

Gambier Tannage.—Calfskins as well as sheep, kangaroo and goatskins can be made into fine soft leather by tanning with gambier. A good process of tanning the skins is applied in practice in the following manner: The skins, after having been bated and washed, are run in an old 12-degree barkometer liquor until colored; they are then put into fresh gambier liquor, being hung therein for about twelve days, during which time the liquor is gradually strengthened every day. The skins are

then pressed and wheeled and shaved or split as they may require; then they are run in a 12-degree liquor for a day or two before being placed in a 34-degree fresh gambier liquor sixteen days more. Salt should be added to the liquors to aid the tanning and to keep the liquors from getting sour. Light skins, of course, require less tanning than heavy ones, the process as described being suitable for heavy kangaroo and calf-skins. The skins, after they are tanned, are washed, set out on a machine, oiled lightly on the grain and dried in a moderate temperature. Skins that are to be colored fancy shades should be dried in a dark room. When dry, the skins improve in texture and feel by being stored some time before finishing. It improves the grain of gambier-tanned leather to drum the skins in a solution of alum and salt for thirty minutes after they are tanned. Seven pounds of alum and five pounds of salt dissolved in seven pails of water make a satisfactory solution for 125 skins. This clears and strengthens the grain. The leather is then drained and either oiled on the grain by hand or run in a drum with five quarts of neatsfoot oil to every 125 skins. After this the leather is set out and hung up to dry. A very satisfactory method of tanning is by the use of vats or tubs with paddles. In the first vat the skins are colored and handled; in the second they are tanned until ready to be skived or split; in the third the skins are tanned out after skiving. At the start the liquor should be four to five degrees barkometer and gradually strengthened as the tanning proceeds until the skins are fully tanned. Into the water in the vats should be put six or seven pails of gambier liquor standing 75 degrees (Baumé test) in the pails or stock solution, also four or five pails of sediment gambier after the boiling. When the liquor is ready, put the skins in and run the paddle wheel thirty or forty minutes to assure a good color on the grain. The liquor should be strengthened twice daily with two or three pails of gambier and sediment, morning and evening, and the paddle should be run three times daily ten or fifteen minutes each time. At the end of four or five days

the skins should be taken out of the liquor and struck out on the flesh and then put into the second or stronger liquor of eight or ten degrees barkometer. By running the paddle three times each day and by adding three pails of 75-degree gambier liquor each day the skins will be well struck through in about fourteen days. Set them out on the flesh side, skin them and then put them into the finishing liquors of 12 to 15 degrees for seven days. Each day the liquor should be strengthened with two pails of gambier and the wheel should be run fifteen minutes each time. One pail of salt should be added to the liquor each week. The final tanning can also be done in a drum.

After they are fully tanned, the skins should be drummed in the solution of alum and salt, oiled and dried.

After the skins are dry they should be dampened, run in warm water and shaved, after which they are fat-liquored, set out and dried again. When dry, the skins are dampened and colored.

Another way to treat the skins is to wash them after tanning, then fat-liquor them, dry them, dampen, shave and mill them in sumac, and then color them.

Sulphonated oil makes a splendid fat-liquor for colored gambier-tanned skins. Good leather is made by fat-liquoring lightly after tanning and washing, then drying the skins out, coloring them and then giving them the second application of fat-liquor.

Dongola Leather.—Gambier, alum and salt make what is known as dongola leather. The first liquor of the process may be made of six-degree liquor and adding thereto ten pounds of alum and seven pounds of salt to each one hundred gallons of liquor. In this liquor the skins may remain for three days, the liquor being strengthened every day, the skins then being pressed and shaved.

The second liquor should be straight gambier, alum and salt being left out. The skins must be watched and the strength of the liquor regulated according to the thickness and condition

of the skins. The strength of the liquor may range from 18 to 20 degrees and three days in such liquor will complete the tanning. The skins are then washed, pressed and fat-liquored with oil and hung up to dry. When dry, the skins are dampened, run in sumac, colored, refat-liquored and dried for finishing.

Tanning with Palmetto.—For tanning with palmetto extract, calfskins should be limed in arsenic limes, then bated with a bacterial bate, or drenched with lactic acid in the same manner as for chrome tanning; pickling, however, can be omitted.

The tanning is begun in cold palmetto liquor, 8 degrees barkometer, the skins being left therein one-half hour. They are then transferred to a drum and tanned with palmetto liquor 30 degrees Baumé, (51 degrees Twaddle) at 75 degrees Fahr. One hundred pounds of skins should be given about sixty-five pounds of extract. After six or seven hours the skins are tanned through. They are then pressed, wheeled, split and shaved and then retanned half an hour in 8 degree liquor, then retanned in a drum one hour with strength of extract 30 degrees Baumé, (51 Twaddle). The leather is now fully tanned. It is washed in cold water, pressed and fat-liquored and dried. When dry, the leather may be retanned in sumac and colored or dyed black, then finished.

Tanning can also be done by suspending the skins in weak palmetto liquor and gradually strengthening the same until the skins are tanned through.

Quebracho and Palmetto Tannage.—Soft, plump and well filled leather is made by tanning calfskins in liquors composed of 75 per cent. quebracho extract and 25 per cent. palmetto extract. The skins are suspended in a weak liquor which is strengthened each day until the skins are tanned through. The leather is then washed, fat-liquored and dried.

Quebracho Tannage.—Calfskins intended for soft upper leather may be tanned with quebracho extract in the same manner as skins for fancy leather.

Quebracho and Hemlock Extracts used in the proportion of one part hemlock to two parts quebracho make a better tan-nage than hemlock alone, which is rather harsh. The skins are nailed on sticks and suspended in weak coloring liquor. The coloring should take about twenty-four hours. The skins are then taken out and placed in a 10 degree barkometer liquor which is strengthened from day to day until the skins are tanned through. Retanning may be done with quebracho and hemlock liquor or with a solution of palmetto extract, preferably in a drum, the skins being then washed, fat-liquored and dried out. Still tanning produces plumper and better filled leather than tanning in drums or in vats with paddles.

Tanning can be begun in hemlock liquor and finished in gambier or palmetto liquor. Palmetto extract is especially suitable for retanning. It puts the leather into condition to stand heat well and to take and carry grease, and it also toughens the leather and makes it more water-proof.

Hemlock-tanned leather is always improved by being re-tanned with palmetto or gambier or with gambier and sumac. The harshness of the hemlock is toned down and the leather takes and retains a better color.

FAT-LIQUORS FOR VEGETABLE-TANNED CALF LEATHER.

The following fat-liquors are suitable for gambier, palmetto, dongola, hemlock, quebracho and combination tanned leather:

Receipt No. 1.—For two hundred pounds of dry leather or four hundred pounds of wet leather, weighed after washing and pressing from the tan, three pails or seven and one-half gallons of the following fat-liquor will be sufficient:

Borax-chip Soap.	24	pounds.
Sal Soda.	12	pounds.
Treated Cod Oil.	15	gallons.
Birch Oil.	2½	gallons.

Boil the soap and sal soda in five pails of water in a barrel until dissolved, then add the oils, stir and boil thoroughly, then add enough water to make forty-five gallons of fat-liquor. This

fat-liquor when made with birch oil is excellent for colored Russia; for black leather the birch oil may be omitted.

Receipt No. 2.—For colored or black vegetable-tanned calf-skins:

Potash Soft Soap.	10 pounds.
Best Neatsfoot Oil.	4 gallons.
French Moellen Degras.	10 pounds.

Boil the soap in twelve gallons of water. Cut the oil by pouring into it and stirring thoroughly four ounces of borax dissolved in a quart of boiling water; then pour the oil into the soap and stir thoroughly. Then add the moellen degreas to the oil and soap and stir again very thoroughly. Run in enough cold water to make fifty gallons of fat-liquor. Ten gallons is enough for fifty skins averaging ten square feet per skin. After the leather is dyed black or colored, press out the surplus water and apply the fat-liquor at a temperature of 120 degrees Fahr., drumming the leather in the liquor forty minutes. Remove the leather from the drum, horse it up for some hours, then strike out and apply a coat of neatsfoot or other suitable oil and hang the skins up to dry.

Fat-liquoring may be done after tanning and washing, the leather being then dried and subsequently dampened and colored.

The drum should always be heated with live steam, the water drained out and the leather run in the drum a few minutes to warm it before being given the fat-liquor. It is also always best to add fat-liquor in portions of a pailful at a time at intervals of five minutes until the requisite quantity has been given to the leather.

Receipt No. 3.—For palmetto and gambier-tanned skins, fat-liquored after tanning, use:

Potash Soft Soap.	1 $\frac{1}{4}$ pounds,
Moellen Degras.	1 quart

for 110 pounds of wet leather. Use at 120 degrees Fahr., and drum the leather fifty minutes, then wash it, strike it out and hang it up to dry. After the leather has been dry some time

it can be sorted and finished into colors or black, or into patent leather, as may be desired.

Receipt No. 4.—To make a barrel of fat-liquor for black or colored leather use :

Potash or Chip Soap	4	pounds.
Sal Soda	1½	pounds.
Treated Cod Oil.....	7	gallons.
Moellon Degras	1	gallon.

Prepare the fat-liquor in the usual manner and use it at a temperature of 115 degrees Fahr. A barrel of liquor will fat-liquor three hundred pounds of leather.

Receipt No. 5.—This is a good fat-liquor for combination tanned skins :

Potash Soft Soap	25	pounds.
English Sod Oil	50	pounds.
Treated Neatsfoot Oil	1½	gallons.

Boil the soap in twenty-five gallons of water until dissolved ; then add the oils and stir thoroughly. A few pounds of degreas may also be added. Enough cold water is then run into the barrel to make fifty gallons of fat-liquor. Twenty gallons of this fat-liquor is required by one hundred pounds of dry leather ; the exact quantity to be used depends, however, upon the nature of the tannage. Some tannages require less fat-liquor than others and a smaller quantity will often produce the desired softness.

Giving Two Applications of Fat-Liquor.—In the manufacture of colored leather excellent results are obtained by drying the leather after washing and pressing from the tan and then drumming the skins in a solution of alum and salt to cleanse the grain and improve the color and texture of the leather, then applying the first fat-liquor, which should be preferably sulphonated oil. The leather is now dried, dampened, colored, dried again and then given the second and main fat-liquoring which may be either sulphonated oil or an emulsion of soap, oil and degreas.

Skins for black and colored leather, imitation kangaroo and dull and glazed boarded grains are also satisfactorily fat-liquored

twice, once after they have been retanned, pressed and sammied, and again after coloring.

After the leather has been retanned, pressed and shaved, it should be uniformly sammied and fat-liquored and then dried. Imitation kangaroo and dull printed grains are generally yellow-backed before the second application of fat-liquor. Blue-backed leather is generally dyed or stained on the flesh and dyed on the grain afterward. Colored leather is usually given the second fat-liquor after it has been colored.

Fat-liquoring is one of the most important processes in the manufacture of leather. Only the best grades of oil, soap and degreas should be used so that the leather will not be greasy or gummy, or apt to spew after it is finished.

SUMAC MORDANT FOR COLORS.

Gambier, palmetto and combination-tanned calfskins intended for colored leather, after being fat-liquored are dried out, then moistened in warm water in a tub and placed in piles for a number of hours to become thoroughly softened. To prepare them for any shade of color they are, preferably, milled in a drum in a solution of sumac prepared in the following manner: For sixty medium sides or ninety average calfskins, one-half of a pailfull of sumac is scalded in a closed vessel for two hours. To the sumac solution are added four pails of water and one gallon of lactracine. The temperature of this liquor, when it is applied to the skins or sides, should be 100 degrees Fahr., and the leather should be run in it for twenty-five minutes. This prepares the leather for the process of coloring, and is a very practical method, simple and easy to use and always productive of good results. It can be applied to skins and sides tanned in any process or combination of processes.

In some instances it is not necessary to use sumac for the purpose of freshening up the leather, it depending upon the nature of the tannage and the condition of the leather. It is always good practice, however, to thoroughly soften the stock

before applying any dye to it; and it is also well to wash the leather in warm water in order to remove from it all the particles of dirt, dust and tannin.

In the treatment of leather that has acquired a dark color from the tannage, it is advantageous to bleach the stock before coloring it. Practical methods of bleaching leather are given in another chapter. They produce good results when applied to calfskins.

When leather has been freshened up in a sumac bath, it is apt to contain uncombined tannin, which has a tendency to cause uneven and cloudy coloring. To prevent such a result, tartar emetic or antimonine may be used. In using either of these articles, the leather is first milled in a sumac liquor. This may consist of one pound of extract of sumac in the required quantity of water, at 100 degrees Fahr., for four dozen medium-sized skins or thirty-two average sides. In this liquor the leather is drummed for twenty minutes, then for the quantity of stock mentioned one-half of a pound of either tartar emetic or antimonine may be dissolved in warm water and added to the leather and sumac, and the drumming continued twenty minutes longer, when the grain will be cleared and ready for the aniline dye. No bichromate of potash or other setting agent is required, as the aniline will be fixed firmly and evenly upon the leather. The leather should be washed off before it is colored.

Titanium Mordant for Colors.—Take one hundred pounds of dry leather and dampen and soften it with warm water. Prepare a solution of eight ounces of titanium-potassium oxalate with warm water and drum the skins in the same ten or fifteen minutes. This gives a yellow-brown base. Run the liquor out of the drum, put in a solution of suitable acid aniline dye and color the leather to the shade wanted. Then wash and fat-liquor the leather, and dry it for finishing.

If basic dyes are to be used, it is best to wash the leather after running it in the titanium solution and then to color it with the aniline dye. Other suggestions in regard to coloring

the leather are given in the Section on side leathers and also in that on sheepskins.

THE COLORING AND FINISHING OF VEGETABLE AND COMBINATION-TANNED CALFSKINS.

After becoming thoroughly dried out the skins may be kept in storage for some time before they are colored and finished. When the coloring and finishing operations are to be carried out, the dried leather is moistened in warm water and placed in piles for twenty-four hours to become thoroughly moistened through and soft. For black leather the flesh is next colored blue or yellow, as may be desired.

For a Blue Flesh a solution of logwood is most commonly used. To the logwood solution may be added a few ounces of blue aniline or of nigrosine. Of logwood extract, paste or powder, one pound of the same may be boiled with a few ounces of borax or sal soda in ten gallons of water and used for each one hundred pounds of leather. The leather is milled in the color solution for twenty minutes, then removed from the drum and dyed black upon the grain with logwood and striker. A stronger solution than that mentioned above may be used, and after the leather has been drumming in it for twenty minutes, it may be spread on a table or run through a machine and the color developed by the application of the striker. This method gives a blue flesh and black grain.

A Good Blue Flesh is obtained from the use of blue nigrosine. For twenty-four skins of medium size, eight ounces of nigrosine are used. This is dissolved in boiling water and applied to the leather at a temperature of 90 degrees Fahr. Running the leather in this liquor for twenty minutes enables it to absorb all the dye, after which it may be blacked upon the grain, oiled off and dried out.

For Yellow Flesh the stock should be uniformly and thoroughly moistened. One-half pailfull of sumac is scalded for two hours in a closed vessel. For use, one gallon of lactracine and four pails of water are added to the sumac

liquor. This quantity of liquor is sufficient for ninety calfskins of average size. The temperature of the liquor should be from 90 to 100 degrees Fahr., and the leather milled in the solution for thirty minutes. Then the skins should be piled up on both sides of the drum and the color solution added. One pound of Yellow S. is dissolved in one-half barrel of water. After the drumming in the sumac, four pailfuls of the color liquor are added to the sumac bath and the leather is drummed therein for ten minutes, or until the latter is permeated with the yellow dye. The grain is next blacked with logwood and striker, then well set out, oiled lightly and the leather dried out and finished in any desired way.

DYEING LEATHER BLACK UPON THE GRAIN.

Some form of logwood is generally used. Logwood chips, logwood extract in paste, and solid and liquid forms are used; also the powdered products of logwood such as Hemolin XS Patd., Hæmatoxylin, and Hæmetine. The use of logwood chips in leather dyeing has been greatly superseded during the last few years by the use of logwood in powder and extract forms. The results gotten from the use of these articles are better and more uniform than the results obtained from the use of chips, since the extracts and powders, and especially the latter, are always uniform in strength and quality. Logwood paste is very excellent so long as it does not get frozen. When once frozen the color produced is not satisfactory, being a muddy grey black. This trouble is not met with in using the powders. Logwood chips require a very thorough and long boiling to get all the color extracted.

When the logwood paste is used from six to eight pounds of the same are dissolved in forty gallons of warm water with one-half pound of borax or sal-soda, and brought to the boiling point. This liquor is very strong and may be reduced in strength by the addition of more water. Hemolin and other powdered dyes are used in the proportion of about six pounds of the powder to a barrel of water. The dye is first boiled for

a few minutes in one-half barrel of water and the barrel is then filled up. From one to two pounds of borax or sal-soda may be added to the dye liquor. A few fustic chips may also be boiled with it and serve to intensify the color.

The leather may be blacked in a drum, on a machine, on tables, or by being folded and passed through the dye in boxes or trays. It is first given the logwood dye, and then the striker. Sometimes two or three applications of the dye are required to get a satisfactory black, according to the strength of the liquors.

Strikers.—(1) Four and one-half pounds of copperas, and one and one-half pounds of blue vitriol, dissolved in one-half barrel of water by boiling. Then the barrel is filled up with water. For use in machine dyeing, twelve pounds of copperas and four pounds of blue vitriol are used for each barrel of water. To this are added one and one-half pounds of ground nutgalls, and one pound of epsom salts to each six pounds of copperas and blue vitriol combined.

(2) Nine pounds of copperas, four ounces sulphate of magnesia, six ounces acetic acid and one ounce nutgalls, mixed together and dissolved by boiling in ten gallons of water, and then turned into a barrel, and enough water added to make forty gallons.

(3) Three gallons iron liquor, two pounds of copperas, dissolved and mixed together. Three quarters of a pound of verdigris dissolved in two quarts of vinegar and added to the copperas and iron liquor. In place of verdigris, three quarters of a pound of blue-stone dissolved in two quarts boiling water may be used. The liquor should be well stirred and allowed to settle, and the clear liquor only used.

(4) Nine pounds of copperas, one-fourth pound of epsom salts, six ounces of acetic acid and one ounce of nutgalls. Forty gallons of water.

Dyeing with Logwood and Titanium Salts.—To color calfskins a deep black the use of titanium-potassium oxalate is recommended. One hundred pounds of dry leather require

about ten ounces of the titanium salt. Dampen the dry leather and run it in a solution of five ounces of the salt for ten minutes. Then put alkaline logwood liquor into the drum and run the leather in it twenty minutes. Another solution of five ounces of titanium salt is then added to the liquor in the drum and the drumming is continued ten minutes, when the leather will be found to be colored, on both flesh and grain, a very satisfactory color. If the leather has not been fat-liquored, it should now be washed, fat-liquored, dried and finished.

RUSSET AND FANCY LEATHER CALFSKINS.

For vegetable-tanned calfskins that are to be colored fancy shades and used for fancy leather purposes, only the finest skins should be selected; they should be free from butcher cuts and other imperfections as much as possible. Light weight skins are to be preferred.

Soaking, liming and bating are done in the same manner as for chrome tanning. To get the skins soft and fine, lime and red arsenic are used. Bating is done with bacterial bate; and after bating, the skins are pickled. To lime and bate the skins in the following described manner produces fine, soft leather that tans and colors satisfactorily: Soak green-salted skins twenty-four hours in clean, cold water; then wash them in a mill for fifteen minutes and next soak them for twelve to eighteen hours so that they will be perfectly clean and soft when they are put into the lime. Trimming and fleshing should be done after soaking and in a careful manner, after which the skins are ready to be limed. The first lime should contain two pounds of lime for every hundred pounds of skins. Slake the lime very thoroughly and mix it into the water in the vat or paddle. On the second day, haul the skins out, plunge the liquor and put them back into it. On the third day, after hauling the skins out, add two pounds of lime to the liquor and put the skins back. On the fourth day, haul the skins out and put them back; and on the fifth day add three pounds of lime and a pound and a half of red arsenic,

thoroughly slaked together, to the lime liquor. All that needs to be done on the sixth day is hauling the skins out, plunging the liquor, and putting them back. On the seventh day, after hauling the skins out, add three pounds of lime and one pound and a half of red arsenic, warm the liquor to 75 degrees Fahr., and put the skins back. On the morning of the eighth day, haul the skins out, heat to 75 degrees Fahr. and put the skins back. Unhairing should be done on the ninth day, when the hair should come off easily. After the skins have been unhaired, wash them for ten minutes in cold water; then refresh them and work them for fine hair. This process of liming produces soft, supple, fine-grained skins. Bating should be done with bacterial bate, such as chicken manure or Puerine, or with a fermented lactic acid bath.

When manure is used, the bating liquor is warmed to 90 degrees Fahr.; the skins are put in and the paddle is run for one hour. Then allow the skins to rest an hour, after which paddle them thirty minutes at a time at intervals of one hour until they are low and soft. They should now be taken from the bate, washed in warm water for five minutes and then pickled. The manure should have been soaking a few days before it is used. For every one hundred skins one bushel of the soaked manure should be used.

Bating with lactic acid in the following manner is more cleanly and simple than bating with manure and really a very good process: Heat water in a paddle to 120 degrees Fahr., and put into it two pails full of dry bran and let it stand over night. The next morning bring the temperature up to 95 degrees Fahr.; add one-half pint of latic acid for every hundred pounds of skins. After stirring the liquor very thoroughly put the skins in and then add another half-pint of lactic acid, making one pint for each hundred pounds of skins. Run the paddle wheel for three or four hours, then take the skins out, wash them in warm water and pickle them. A clear grain is essential on fancy leather; and this method of bating, followed by washing and pickling, makes the grain clear and even

and the skins soft and yet plump. Pickling, which is also essential for fancy leather, is done in a paddle wheel. For every one hundred pounds of skins use fifty pounds of salt and one and one-fourth pounds of sulphuric acid. This quantity of salt is for the first lot of skins only. For the next lot of skins and all lots following, ten pounds of salt and one and one-fourth pounds of acid are sufficient. Run the skins in the paddle two hours and let them lie in the liquor a few hours or over night. Then let them drain over horses for twenty-four hours before tanning them.

Vegetable Tanning Processes.—Calfskins for fancy leather purposes are tanned in numerous ways. Quebracho extract, in either solid or liquid form, is in common use. It produces soft, tough leather. It is also combined with hemlock and palmetto extracts. A practical way to tan calfskins with quebracho extract is carried out as follows: A quantity of the extract is boiled with water until it is dissolved. Solid extract should be dissolved in a tub containing a false screen bottom which prevents the extract adhering to a solid surface. The liquid extract should be dissolved in water standing at 180 degrees Fahr. The resulting solutions from both grades of extract should be stirred well and allowed to cool down gradually before being used. It is a great mistake to suddenly chill the extract solution by running it into cold water or vat-liquors.

Skins should always be started in a weak liquor; and having the liquor too strong and thereby drawing the grain must be carefully guarded against during the entire process. The suspension method, by which the skins are not violently agitated, produces the plumpiest and best tanned leather, especially along the sides and in the flanks. The skins are held in suspension by tacking them on wooden strips, using galvanized iron or copper nails so as not to stain them.

The first liquor, in which tanning begins, is quite weak. Its strength should not exceed 10 degrees barkometer. Salt must be added to the tan liquors to prevent the acid in the skins from doing any injury. As the tanning progresses the liquor

is strengthened until it reaches 20 to 25 degrees towards the end of the process. The length of time required to accomplish the tanning of the skins depends upon their thickness and the strength of the liquor. It is better to tan slowly so as to get a fine, smooth grain than to hasten the process and get a rough, coarse grain. When the tanning is completed, the skins should be washed, pressed and fat-liquored. From seven to fourteen days is usually the time required to fully tan the skins.

Hemlock and quebracho extracts combined make a good tannage. The quebracho tones down the harshness of the hemlock and makes soft leather of good color. The tan liquors should be about two-thirds quebracho to one-third hemlock; and this proportion should be kept up during the process. The strength of the liquors is increased daily until it is about 25 degrees barkometer and the skins are fully tanned.

Quebracho and palmetto extracts make a very desirable upper and fancy leather tannage. The correct proportions are seventy-five per cent. quebracho and twenty-five per cent. palmetto. The leather produced by the combination is plump, full and mellow; and owing to the rapid tanning qualities of both extracts, tanning is completed in a comparatively short time. The process is carried out by suspending the skins in weak liquor, say 8 to 10 degrees barkometer, and gradually increasing the strength of the same until the skins are tanned. This combination may also be used for retanning hemlock leather. For some purposes it may be advisable to modify the combination, but for most purposes three-fourths quebracho and one-fourth palmetto will be found satisfactory.

Fat-Liquoring.—For the purpose of making the leather soft and supple some sort of grease is required. The best results are obtained when an emulsion of oil and soap, or of soap and moellon degreas, or a solution of sulphated oil is applied to the skins. Any good fat-liquor may be used. A good one is made of:

Palermo Fig Soap	10	pounds.
Neatsfoot Oil.....	4	gallons.
Borax	1½	pounds.

Dissolve the borax in ten gallons of hot water in a clean barrel. Put in the soap and boil with steam until dissolved. Then add the oil and continue boiling for fifteen minutes; then add sufficient water to make twenty gallons of liquor. Give the leather just enough to make it very soft without being greasy, and drum it in the liquor for forty minutes. Then strike the skins out on the flesh side and hang them up to dry.

Another excellent fat-liquor consists of five pounds of soap and nine pints of moellon degreas, in sufficient water, say one-half barrel, for four hundred and fifty pounds of leather. When the skins are tanned, remove them from the tan liquor and wash them in lukewarm water; then press them. Heat the drum with live steam, put the skins in and start the drum. Put the fat-liquor in through the hollow axle and run the drum for forty minutes. Then open the door and let water run on the skins to wash them for ten minutes. Hang the leather up to dry. When dry, let it lie in the dry condition as long as possible before finishing it. Then dampen the skins, shave, color, and dry them for the final finishing. Good leather is also made by drying the skins after tanning, then dampening, shaving and coloring them, fat-liquoring after coloring, and then drying them for finishing. The use of sulphated oil is recommended for this kind of leather. The skins may be given two applications of the oil in the following manner: After they are washed and pressed from the tan liquor, drum them in a solution of the oil in warm water, and dry them out. When they are dry, the skins are dampened and colored, and then given another application of the sulphated oil, after which they are dried and finished.

Preparation for Coloring.—After the skins have been dry for some time, they are sorted and colored. Those that are light in color, clear of grain and free from imperfections, are colored the lightest and most delicate shades. Those that are not suitable for colors are dyed black. The skins are drummed for

thirty minutes in a sumac liquor to freshen up the grain. They are then struck out and shaved, and are then ready to be colored.

If the skins are of light and clear grain they do not need to be bleached; but where the tan has made them dark a bleaching treatment is necessary. Borax and sulphuric acid are used both for plain russet and colored leather, followed by a sumac bath, as described under bleaching. The leather is always given the sumac bath whether it is bleached or not. One to two pounds of sumac in water at 105 degrees Fahr., is enough for one dozen skins. After they have run in the sumac bath, the skins should be rinsed in warm water to remove adhering sumac, and they are then ready to be dyed. Coloring may be done in a drum, in a paddle vat, or by brushing the dye on by hand. The drum method is in most general use.

A very satisfactory way to treat the leather is to wash and press it after tanning, then to give it a light application of sulphated oil, and dry it out. The dry leather is then dampened, bleached or not as it seems to require, treated with sumac, colored and re-fat-liquored, and again dried.

Coloring.—For one hundred pounds of skins weighed in the dry condition, dissolve eight ounces of titanium salts in warm water and run them in the solution for fifteen minutes. This gives a yellow base on which any shade of color can be obtained. Run the liquor out of the drum; put in the acid aniline solution according to the shade wanted and drum the skins in it for twenty minutes. Then wash them, give them the second application of fat-liquor and hang them up to dry. When the skins are fat-liquored only once, they may be so treated either immediately after tanning or after they have been colored.

When basic dyes are to be applied, it is well to wash the skins after the titanium bath, then to run them in the basic dye solution to bring to the shade wanted, and then to wash and fat-liquor them.

All shades of tan, brown, oxblood, red, green, blue, etc., are easily obtained on a titanium mordant; and the colors are fast, deep and well developed. After coloring and fat-liquoring, when fat-liquoring is done after coloring, the skins are struck out carefully and thoroughly, and either hung up or tacked on frames to dry.

Black Leather.—If black leather is wanted, the skins are taken after the first dying, moistened, shaved and run in sumac and then colored. An excellent color is secured by using the following process: Drum one hundred pounds of leather, weighed dry, in a solution of five or six ounces of titanium salt in warm water, for ten minutes. Then pour a slightly alkaline logwood-fustic liquor into the drum and run the drum twenty minutes; then add to the contents of the drum another solution of five or six ounces of titanium salt and run the drum ten minutes longer. If the skins are being treated with sulphated oil, wash and fat-liquor them, and dry them out. If they have received no fat-liquor at all, wash them and apply the fat-liquor, and then dry them out. This method of coloring carries the dye deeply into or right through the leather, which is usually considered desirable on this class of leather. Logwood liquor is made by boiling one and a half pounds of logwood crystals and four ounces of salts of tartar or of borax in ten gallons of water. To the solution are added four ounces of fustic paste. The liquor is then stirred and allowed to cool before it is used.

Other methods of coloring are to run the leather in the logwood liquor and then develop the color with copperas and bluestone or other iron liquor, either in a drum or by running the leather in the logwood, and then applying the iron liquor to the grain only by hand or machine. This leaves a blue flesh and black grain.

Aniline-black may be used with good results. Blue-black the skins by running them in a solution of eight ounces of methyl violet for two hundred and fifty pounds of leather. Then fat-liquor or re-fat-liquor them in the drum; next run in solution of aniline black with green cast, four to six ounces,

and solution of titanium salt four ounces, and drum from ten to fifteen minutes. Strike the leather out and hang it up to dry.

Finishing.—Finishing consists of staking, tacking, seasoning, glazing, ironing or graining the leather. For smooth glazed finish, the skins are staked, tacked and seasoned; then glazed. A colorless seasoning is used on colored skins. The seasoning is put on with a sponge or sheepskin pad clipped close and even; and it should be put on evenly and rubbed into the leather. When it is dry, the skins are glazed. For dull finish, they are rolled or ironed. If very soft leather and smooth, bright finish are wanted, the skins are seasoned and glazed, staked, seasoned and glazed again, and perhaps staked again, seasoned and glazed the third time. Boarded finish is obtained by graining and printing the leather. Embossed grains are obtained by embossing the leather with any desired grain. The leather, when finished, should be soft and pliable, and tough enough to stand pulling and bending without injury.

Bleaching Hemlock-Tanned Skins.—These skins can be given a lighter shade resembling oak calf by bleaching them in sumac. They may be drummed in warm sumac liquor or they may be allowed to rest in it several hours. The fat-liquoring may be done with a mixture of soap, oil and degreas, but the skins do not require very much fat-liquor. If they are to be colored, it is advantageous to treat them with sumac and no other bleaching is necessary. If the leather is very dark and dirty, treatment with borax and sulphuric acid should precede the treatment with sumac. The exact treatment that the skins require must be determined by their condition. For some the sumac treatment is sufficient while others require the borax and acid treatment also. Hemlock-quebracho tanned skins have good color, and very little or no bleaching at all is required.

LIGHT RUSSET COLOR ON LEATHER.

A light shade of russet is secured on vegetable-tanned leather by first bleaching with borax and lactic acid, then applying a

fustic liquor and next coloring with Philadelphia yellow and Nankin yellow. This process is especially suitable for combination-tanned leather.

To prepare the bleaching liquor, put one bushel of rye bran into a barrel filled with warm water and let it ferment and become sour; it is then ready for use. Use three pails of the bran liquor and four pounds of borax for one hundred and fifty pounds of leather that has been fat-liquored and dried. Dampen the leather with warm water, and when it is soft, put it into a drum together with nine pails of water at 90 degrees Fahr. Add the borax dissolved in hot water to the water in the drum, and run the leather in the solution ten or fifteen minutes. Then throw in the bran liquor and run the drum fifteen minutes longer. The borax cleanses and saponifies whatever fat there may be in the grain of the leather, and the lactic acid opens up the grain so that bright and clear coloring is obtained. A weak solution of sulphuric acid may be used in place of the bran liquor but it is more liable to weaken the fibers of the leather.

After the treatment with borax and bran liquor or acid, the leather should be washed very thoroughly and given the fustic liquor. Dissolve two pails of fustic extract and two quarts of salt in a barrel half full of boiling water; then fill the barrel up with water. For the one hundred and fifty pounds of leather use three pails of fustic liquor and eight ounces of alum. Dissolve the alum in a little hot water and add the solution to the fustic liquor, then add the fustic-alum liquor to nine pails of water heated to 90 degrees Fahr. Drum the leather in this solution fifteen or twenty minutes. Dissolve eighteen ounces of Philadelphia yellow, thirteen ounces of Nankin yellow and six ounces of cream yellow. Add nine pails of water and use the solution at 110 degrees Fahr., running the leather in it twenty minutes. Use alum to set the color. Dissolve a double handful of alum and add it to the water in which the leather is rinsed after coloring. Rinse the leather, dry and finish it. Leather that has not been fat-liquored may be cleared with alum and salt,

then drummed in fustic liquor and colored as above directed. After coloring, the leather is hung up and dried, then dampened and fat-liquored, dried and finished. This method of treating the leather produces a light, uniform russet color.

DARK RUSSET COLOR ON LEATHER.

A dark russet color can be obtained by applying the following process to one hundred and fifty pounds of combination-tanned leather dried out after tanning and without being fat-liquored:

Dampen the leather with warm water, then put it into a drum with seven pails of water heated to 90 degrees Fahr. Dissolve three quarts of alum and five quarts of salt in three gallons of hot water and add the solution to the water. Drum the leather in the liquor fifteen minutes, then wash it, and it is ready to be colored. For this purpose run it in a solution of nine pails of water at 90 degrees Fahr., to which three-quarters of a pail of logwood and three pails of fustic liquor have been added. At the end of twenty minutes stop the drum and drain the liquor out. Dissolve in boiling water twenty-four ounces of bronze No. 2 and three ounces of acid orange; add the solution to eight pails of water at 110 degrees Fahr. Drum the leather in this solution twenty minutes; then stop the drum and drain the liquor off. In the meantime dissolve in boiling water one pound of Nankin yellow Y, one-half pound of cream yellow and two ounces of Bismarck Brown B. Add the solution to seven pails of water at 110 degrees Fahr. and drum the leather in the liquor twenty minutes; then drain the liquor off and hang the leather up to dry before anything else is done to it. Then take the dry leather, dampen it with warm water and, when dampened through, and soft, apply a liberal quantity of fat-liquor. Set the leather out on both sides and then hang it up or tack it on frames to dry for finishing.

SECTION FOUR.

THE COLORING AND FINISHING OF INDIA-TANNED SKINS.

INDIA-TANNED sheep and goat skins in various colors and finishes are used for shopping and traveling bags, belts, collar boxes, bookbinding, carriage trimming, linings, and in the manufacture of leather novelties and specialties. These skins have considerable firmness and durability and yet are soft and pliable and, when colored and finished, cannot be excelled by any other leather. They can be finished in heavy and light weights, with any kind of grain, in all colors, glazed and dull, smooth, grained and embossed; they can be made into firm or soft leather as desired. The large heavy skins are used for suit cases and bags, the smaller ones for other purposes where light, soft leather is required. Bookbinders use India skins in a variety of colors, the staples being dark greens, dark blues, dark wines and blacks, with pebble grain. These skins are colored and finished and then split into the desired substance, as bookbinders' leather must be fairly thin to cover the backs and corners of books.

In the preparation of India-tanned skins for coloring and finishing, it is necessary to first thoroughly soften and wash them so as to remove from them all surplus tannin, particles of dirt and dust. Before washing is begun, it is best to soak the skins in warm water, then let them lie in piles for a few hours to soften. As soon as they are wet and pliable, they are transferred to a suitable drum and washed. The water used should be at a temperature of 90 degrees Fahr.; and its efficacy is increased by dissolving and adding to it some borax or washing soda, in quantity from two to three pounds for each hundred gallons of water. The skins are washed in this solu-

tion for fifteen or twenty minutes, when they are washed in clean water and made ready for further treatment.

The skins as they are received from India are imperfectly tanned, of a dark color and quite hard. In order to complete the tanning and to improve the quality of the leather by making it softer and better adapted for fancy colors, it is necessary to remove from it some of the original tanning material, and to replace it with one that makes soft and light-colored leather. For light-colored leather it is also necessary to bleach the skins with sulphuric acid after the borax bath.

A good method of treatment is to wash the skins in borax water, next in clean warm water, and then to treat them with a weak bath containing sulphuric acid. The borax used in washing, while it cleanses the skins perfectly, also darkens the color; the acid bath brightens up the leather. Very thorough washing is necessary afterwards to remove the acid. Other acids may be used in place of sulphuric with good results. To a barrel of water enough acid should be added to bring the solution to the degree of strength that will bite the tongue when tasted. From two to three ounces per gallon of water may be used. Drum the skins in the acid solution, then after washing, for twenty minutes, remove them and run the water out of the drum. Then wash the skins until no acid can be detected in the water coming from the drum. They are now ready to be treated with sumac.

The sumac liquor should be quite strong and at a temperature of 105 degrees Fahr.; and the leather can be treated either in a drum or paddle vat. One to two pounds of sumac may be used for each dozen skins. They are run in this sumac liquor from thirty minutes to an hour; after this they should be washed in warm water to remove adhering sumac, struck out with a slicker and hung up to dry. When they have dried, they can be colored any shade of color. Coloring can also be done immediately after washing from the sumac, but best results are secured by drying the skins first and then coloring them.

In place of sumac, quermos extract may be used; also palmetto. Quermos produces a color equal to sumac, and is stainless. It is used in the same manner as sumac. After washing from the retan, the skins have a nice russet color, and they can be finished without coloring and used for some purposes, or colored with aniline dye.

Borax not only removes some of the tanning material, but also washes out much of the natural grease that the skins contain. The acid bath brightens up the leather, and the sumac liquor replaces the tan washed out, thus retanning the leather and making it softer, and prepares the grain for the subsequent coloring process.

Some tanners make use of hyposulphite of soda in the wash bath in place of borax. Ten pounds of it are dissolved in a barrel of hot water, and the solution is used at 110 degrees Fahr. A few minutes' washing afterwards is all the skins require.

Coloring the Skins.—To prepare the dry leather for coloring, the skins are moistened with warm water in a drum or tub. One way to color the skins is as follows: Run them in a drum with warm water until they are soft and opened out. Then pour into the drum, through the axle, from two to five ounces of tartar emetic for each dozen skins, according to their size, and run the drum fifteen minutes. This clears the grain and sets the dye applied afterwards. Drain the water out of the drum and run in the dye liquor.

Another and most excellent process is to drum the skins in a warm solution of titanium-potassium oxalate (eight ounces for one hundred pounds of dry leather) for ten or fifteen minutes, then rinse the leather and apply the dye. This process is recommended, as it mordants with a titanium tannate, itself a yellowish shade, on which all shades of tan, brown, green, blue, and maroon can be readily obtained. The titanium solution can be applied in a drum, as directed, or in a paddle-vat or a tray, or by brushing on with brushes. After running off the liquor, a slight rinsing in warm water is advis-

able, but not always necessary. If acid dye is to be applied, the rinsing may be omitted; if basic dye is to be used, it is necessary to wash the skins only when the mordant bath has not been fully exhausted. If the mordant is all taken up, washing can be omitted, the liquor being run out of the drum and the dye solution put in. For bag, hat, pocketbook and bookbinders' leather, in which India skins are finished, this process of coloring is quicker and cheaper than any other. After the skins are dyed to the shade wanted, wash and finish them.

Dyeing the Skins Black.—India-tanned skins can be dyed through flesh and grain by the use of logwood and titanium salts. A fairly strong logwood liquor, slightly alkaline, should be used, and ten ounces of titanium-potassium oxalate for one hundred pounds of dry leather. Dissolve half of the titanium salt and drum the leather in the solution ten minutes. Then put the logwood liquor into the drum and run the skins in it fifteen minutes. Finally, to complete the process, pour the rest of the titanium salt in solution into the drum and continue the drumming ten minutes; then wash the skins. No copperas or iron liquor is used, as logwood and the titanium salt dye a deep, permanent black. It is advantageous to use logwood crystals and to add a little fustic paste to the liquor to intensify the color.

To color flesh and grain black with aniline dyes, the skins should be drummed in a solution of methyl violet and then in an aniline black solution. Two hundred and fifty pounds of dry leather require eight ounces of methyl violet aniline and six ounces of aniline black. Drum in the violet solution twenty minutes, next in the aniline black liquor to which four ounces of titanium-potassium oxalate in solution have been added, for fifteen minutes, then wash and finish. The seasoning used in the finish should contain one pound of titanium salt to the barrel of seasoning. The aniline black should have a green cast to get the best black. Skins that are to be fat-liquored should be fat-liquored after drumming in the violet aniline, and then dyed with the black aniline.

The flesh can be colored blue by the use of blue nigrosine. For each dozen skins two or three ounces of the nigrosine are dissolved in hot water and applied at a temperature of 110 degrees Fahr. The skins are drummed in the solution twenty minutes; then blacked upon the grain, by hand or on a machine, with logwood and iron liquor or with logwood and titanium salts, rinsed off and dried.

The skins can also be drummed in an alkaline logwood liquor until colored, then spread upon a table or run through a machine and the grain blacked with iron liquor. This method of coloring also produces blue flesh and black-grain, which is usually considered desirable.

Black Glazed Finish.—The dried skins, after staking, are ready to be finished. They can be glazed, finished smooth, dull, grained, or embossed as the finisher may desire. A good luster and soft feel is obtained by seasoning with the following dressing, and then glazing:

Egg Albumen	1 pound.
Orchil	1 pint.
Sperm Oil	1 quart.
Logwood Liquor	6 gallons.

Dissolve the egg albumen in a quart of rain-water; strain into a large bucket or can, and add the orchil, sperm oil and logwood liquor, stirring the mixture very thoroughly. To get a clear grain, dissolve one ounce of nigrosine in a gallon of water, add to this a small quantity of wood alcohol, and cover the skins with one coat. This should be done before the leather gets the first seasoning. When dry, apply the seasoning, dry, and glaze. An elegant glazed finish also results from the use of the following seasoning:

Logwood Liquor	6 quarts.
Blood	2 quarts.
Orchil	$\frac{1}{2}$ pint.
Water	1 quart.
Ammonia	$\frac{1}{2}$ pint.
Milk	1 glassful.

Apply a coat of this seasoning, and when it is dry, glaze; then give another coat and glaze again.

Smooth Dull Finish.—A fine dull finish and soft, full skins are obtained in the following manner: After staking, the skins are given a coat of dressing, dried, then given another coat of dressing, dried and ironed; then they are staked. The seasoning is made of:

Ivory Soap	1 pound.
Neatsfoot Oil	1 pint.
Whole Flaxseed	$\frac{1}{2}$ pound.
Beeswax	3 ounces.
Black Nigrosine	3 ounces.
Powdered Aloes	1 ounce.
Wood Alcohol	$\frac{1}{2}$ pint.

Boil in two gallons of water for one-half hour, the soap, oil, flaxseed and beeswax. Cool and strain. Then dissolve the nigrosine in a quart of water and also the aloes in the wood alcohol and add both solutions, one after the other to the finish. This seasoning makes a fine dull finish with a soft, dry feel.

Finish for Colored Skins.—Prepare a week before it is to be used the following dressing:

Blood Albumen	4 ounces.
Granulated Gelatine	4 ounces.
White Varnish Shellac	$\frac{1}{2}$ pint.
Ammonia	$\frac{1}{4}$ pint.

Soak the albumen in a gallon of water over night. Boil the gelatine in a gallon of water and let it cool. Mix the shellac with the ammonia. Mix the solutions and add enough water to make three gallons of finish. Apply with a sponge and when dry, glaze. For plain, natural finish apply two coats and roll the skins while wet; then dry them; when dry, give another coat of the finish. If the ammonia evaporates before the dressing is used, colored skins will not be spotted.

An egg albumen solution also produces a fine glazed finish. A good formula is:

Water	5 gallons.
Bichromate of Potash	$\frac{1}{4}$ ounce.
Acetic Acid	1 pint.
Egg Albumen Solution	1 gallon.

Mix all together and keep in a cool place.

India-tanned skins are finished in various ways. They are grained by a roller or embossed and then boarded up by hand. Some are glazed and grained. For some purposes, such as shopping bags, ladies' belts, etc., they are hand-grained three ways which give a round and half round grain. To get a diced grain, the skins are rolled with a straight grain roller and then grained crosswise; after this they are boarded up, which softens them and produces a uniform grain similar to box grain. The finish that is put on depends upon what purpose the leather is to be used for. Some skins are pebbled and then boarded; others are glazed and brass-boarded, while large quantities are finished in smooth glaze and dull, and embossed grain.

Retanning with Chrome Liquor.—A method of retanning India skins with one-bath chrome liquor is as follows: The skins are first sorted and all superfluous parts trimmed off; they are then soaked and shaved. After shaving, they are drummed in warm water containing borax to wash out the tan and enable them to take the chrome liquor. They must be very thoroughly washed but not too much or the finished leather will suffer. When the washing is completed, they should be drained a few hours and then be given the chrome liquor. Any good one-bath liquor may be used, or a solution of chrome alum and soda may be prepared and the skins run in it. Sufficient water is put into the drum, and a quantity of salt added, and the skins are drummed in this solution one hour. Chrome liquor is then poured into the drum, a gallon at a time and the drumming continued until the skins are fully tanned. They are next washed in borax water for thirty minutes and then in clear water for the same length of time.

The surplus water is now pressed or struck out and the leather is dyed. The flesh is colored blue and the grain black in the manner that has been described; the leather is then rinsed off, struck out and hung up to dry, and when dry staked, seasoned and finished in glaze or dull.

FINISHING INDIA-TANNED SKINS INTO BOOK-BINDING
LEATHER.

India-tanned skins that are to be colored and finished into leather for book-binders' use are first sorted, dampened and shaved. Shaving is done for the purpose of removing the loose flesh and making the skins smooth and of uniform thickness; it is generally done on machines. After shaving it is necessary to wash them quite thoroughly in warm water containing sal soda, borax or soap to remove dirt and tanning material, after which, if they are to be colored light shades, they are drummed in a weak sulphuric acid bath, washed, and then retanned with sumac. A dilute solution of soap is very effective in washing. Skins for dark colors do not need such thorough washing; bleaching also is unnecessary. After the treatment with sumac, the skins are in condition to be tanned.

Coloring is usually done in a drum. A sufficient quantity of dye, heated to the temperature necessary to penetrate the skins, is put into the drum, and the latter is run until the leather has absorbed the dye and is colored. Sometimes it is necessary to put in a bottom color first, then to add another color and then another as each color is taken up by the skins. This method of dyeing colors the leather on both sides. Acid dyes are generally used, it being customary to add to the dye-bath a quantity of sulphuric acid, generally equal in weight to about double that of the dye used. After the leather is colored it is rinsed or soaked in water for the purpose of removing the acid, but it is impossible to remove all the acid and it is what remains of it in the leather that causes book bindings to become weak and rotten. In place of sulphuric acid, formic acid, acetic acid or a little bisulphate of soda should be used. The use of formic acid is advisable. It is necessary to use just twice as much formic acid as of sulphuric, otherwise the treatment is the same. Formic acid is entirely evaporated after dyeing, hence has no harmful effects.

The coloring may also be done by hand, but this method is slower and more expensive than drum-coloring. The leather is

spread out wet upon a table and a foundation color is brushed or rubbed in, then other dye is applied until the right shade of color has been obtained. In this process of coloring acid dyes are also used because they are faster to light than the basic dyes.

Another way of coloring is to obtain marble effects. A manufacturer of book-binding leather describes his method of coloring for marble effect and finishing in the following words: "The wet skins are rolled up into a round ball, each of them carefully arranged so that no very large part of it is hidden in the folds. This ball is then dropped into a bucket. The color, of course, takes only on the edges, the folds keeping the color out. This produces a beautiful coloring or marble effect, and is somewhat similar to the treeing of calf. The skins, when taken from the coloring wheel, are put out. Over a low, slanting bench, they are laid flat and men with glass slickers press them out in various directions, forcing out all the surplus coloring material, and smoothing them out perfectly flat. This is a very necessary operation for if the old tan wrinkles are not worked out at this time they never will be. This work is also being done on a machine. The hand does the better work, though at much greater expense.

"There are two ways of drying. One is to hang up in the hot room on nails, the other to tack out on boards. The latter one is the usual way for book work as the stretch must all be taken out and the skins left perfectly flat. In heat of about 90 to 100 degrees Fahr. it takes about one day to dry properly. Drying in heat cannot be done with sheepskins as they would become brittle. The method of finishing depends upon whether the proper color has been reached and whether a dull or a bright finish is wanted.

"As some leathers are wanted very soft and exactly opposite to book stock, the skins for this finish are staked. Sometimes it is necessary to give them a little more color to fill the pores up a little, especially if the stock is made brighter. This is of the utmost importance to bookbinders for the same mixture

that is put onto the leather at this time is what every book-binder should wash his books with. Boil a little flaxseed in water, then add a little milk and apply before ironing, allowing full time to dry.

“There are three different ways of giving the leather a grain or the morocco finish as it is called. The best way, of course, is by graining it up naturally without giving it any false grain. This is done by a cork board when the skin is wet. The grain of the skin is turned to the grain and then pushed backward and forward in eight ways, turning the skin each time. This method throws up a beautiful grain and makes a more or less regular morocco figure. Heavy skins throw up a large grain, while that of light ones is fine and small. To keep this grain in so that it will not pull out, the skins are hung up in the heat and dried. This, of course, makes them hard and stiff and it is necessary to go through the same method again only with the skin dry instead of wet. This keeps the former grain and makes the leather soft and pliable.

“Another good way to do where prices enter into the question is to take the skins from the dry room, wet them and put them under a jig roll. This is a small steel roll about six inches long, cut with indentations, so that the roll under great pressure on wet leather gives a pebbled or morocco figure. This also must be dried in, then wet down and hand grained just exactly as the natural grain skin. This gives a beautiful regular morocco grain that will not pull out or flatten, and it is done at no deterioration to the leather itself.

“The poorest way, though much used, and really the best known among bookbinders, is embossing. The objectionable feature to this process is that to keep the figure in it is necessary to use heat, and a lot of it. This injures the fibers and the grain, leaving the leather with an unnatural grain. Of course this may be broken up more or less by dry graining, but this only makes the grain pull out very easily. No good work should ever be embossed. The process is most fit for sheepskins or other skins when no other method will do, or else for

very poor stock which will not look good when finished in either of the other two ways. The grain can be made bright at any time during these processes by glazing on a glazing machine.

“The leather, no matter how finished, is now ready for splitting. This can be done any weight desired. While it aids in the making of the book, split leather will not wear so many years as unsplit. The fibers are cut right in half, and the flesh part being the strongest part of a skin, one-half of its strength is lost. Unsplit leather would cost more than split, the work and cost of making the book would be greater, and so unsplit leather, even though it be the best, is very seldom used on morocco, though on buck and India sheep the reverse is true.”

Some of the splits taken from India-tanned skins are made into ooze; some are used for leather pillows; some for covering handles of golf sticks, for linings of purses, bags, etc. Crushed Levant grain is obtained by embossing the skins, then seasoning and glazing them as the grain must be flattened out. Two or three glazings are necessary to get the proper finish. The colors are generally blue, red, green, brown, tan and wine colors. To get the best results in coloring, it is advisable to have the skins embossed before coloring, and coloring afterwards by table coloring, which will leave the crevices of the grain a lighter hue than the upper surface, which is desired, besides leaving the flesh clean and white. Other grains also can be treated in like manner with good results.

Plump leather always takes a better grain in boarding. When it is possible to select skins for boarded grains it is best to roll them with a diced or straight grain roller. Should the latter be used, the skin should be rolled diagonally, to form a small diamond, which is afterwards hand boarded; this breaks up the machine roll impression and forms the grain so much desired. The spots at the butt of the skin generally pipe or blister and should be lightly gone over with the hand board. The leather, if sufficiently plump, can be finally split so that the grain will come out the desired weight. The grains finished as

described are used for collar and cuff boxes, belts, hand bags, pocket books, music rolls, and other purposes.

OOZE OR SUEDE LEATHERS.

There are many varieties of ooze leather, almost all kinds of skins being made into it, and various tanning processes used. The leather resembles undressed kid glove leather in appearance, but for some purposes it is heavier and less soft. Ooze skins are used in the manufacture of fancy leather goods, hats and caps, books, leggings, spats, shoes, slippers, and many other articles. Skins that have defective grain can be made into ooze leather more profitably than into leather finished on the grain. The flesh side can be finished or the grain can be removed after the skins have been limed; they are then tanned in any suitable process. Slunk calf skins make very fine ooze leather. The stock intended to be made into ooze leather is worked through the beam-house and tanned and finished expressly for ooze finish. Tanners of chrome and vegetable tanned leathers and finishers of India-tanned skins, however, find many that have poor grains, and these they finish into ooze leather. India-tanned sheepskins in ooze finish find ready sale, but the color must be reliable. These, as well as other vegetable-tanned skins, are finished on the flesh side and used for belts, bags, fancy slippers, etc. Softness and good color are the essential qualities. A short, smooth nap is also important, which is obtained by the skins being ground on stones made for this purpose. Coloring is done after grinding.

The following description is an outline of the methods used in finishing of India-tanned ooze leather:

- The skins are assorted and those that have good grains are taken and colored and finished upon the grain, while those that have poor grains and other imperfections are thrown aside for ooze finish. These imperfect skins are then thoroughly washed and cleansed of dirt and surplus tanning material; they are then struck out to rid them of surplus water, and then ground while in the wet condition. The next process

is retanning with sumac, which not only retans the skins but prepares them for coloring also. The sumac is applied in a warm solution in a drum, after which the skins are colored. Coloring is done in either a drum or tray, preferably in a drum, as it consumes less time and is more uniform, the tumbling and pounding of the skins serving to pound the color into them. When colored they are fat-liquored, dried, softened by perching and knee-staking, and then ironed. Ironing must be carefully done or the nap will have a shiny look that is undesirable; if the iron is too hot it will burn the skins. The latter can also be run on emery-buffing wheels when staked and dry, which makes them soft and smooth. Grinding on stones while wet and before retanning, is the best way to treat the skins, as it produces the close nap that is so essential on the finished leather. Prevailing colors are gray, tan and brown.

When the skins are tanned for ooze finish, they are tanned, colored, fat-liquored and finished in about the same manner as mocha glove leather; various other tanning processes are also used, chrome, alum, etc., that make leather with the requisite softness and fine feel. The color should always be uniform through the skins so that the edges will not show a different shade. Chrome-tanned ooze leather is of comparatively recent introduction. It affords the tanner a profitable outlet for skins that would otherwise make only a very low grade of grain-finished leather.

CHROME LEATHER FROM INDIA-TANNED KIPS.

India-tanned kips, when carefully retanned with chrome liquor, make very serviceable leather that partakes of the nature of both vegetable and chrome tannages. A few suggestions as to how to retan and finish this kind of leather may be of service to the tanner.

The kips are first soaked in warm water and then placed in piles to soften. When the water has penetrated the hides, they are run in a drum for a quarter of an hour to soften them and to remove the dirt and plaster adhering to them. They

are next cut down the back into sides for more convenient handling, and are then split on the belt-knife machine. As the hides are not fully tanned a great deal of care is necessary in splitting in order to prevent cutting and gouging. The knife must be kept in perfect condition, and the hides must be neither too wet nor too dry, or they will split very unevenly. All the rough flesh around the edges and shoulders should be trimmed off before the hides are washed. Washing is done with sal soda and warm water in a drum. The object of washing is to remove the excess of tannin so that retanning can be done. From two to three pounds of sal soda should be used for each hundred pounds of dry leather. It is dissolved in warm water and the hides are drummed in the solution at least thirty minutes and perhaps longer as they seem to require it. The temperature of the water should be about 95 degrees Fahr. After the leather has been washed for half an hour, it should be thoroughly washed in warm water and made as clean as possible before it is retanned. For this purpose a good one-bath liquor should be used. The washed hides, after draining several hours, are put into a drum with a sufficient quantity of water to cover them, and a few pounds of salt are added and dissolved. The drum is started and the chrome liquor is then poured in through the hollow axle. The liquor should be added in three portions, the first after the hides have been drumming in the salt water a few minutes, the second after fifteen minutes, and the third thirty minutes after the first portion, and the drumming should then be continued for at least an hour, and longer does no harm. The sides are then placed over horses and allowed to drain for twenty-four hours. They are next washed for twenty minutes in borax water at 100 degrees Fahr., one pound of borax being used for one hundred pounds of wet stock, and then in clean water to remove all traces of acidity and tanning salts. In order to expedite matters, it is practicable to add a little purple aniline or blue nigrosine to the borax water toward the end of the process to color the flesh and give a bottom color for the black.

After washing, the water can be drained off and fat-liquor put in without taking the leather from the drum. The best way to fat-liquor, however, is to take it from the drum, press it and then run it in a warm drum before giving it the fat-liquor. Any good chrome fat-liquor can be used. The leather should be drummed in it for forty minutes, then drained twelve hours and then either struck out by hand, or run through the striking-out machine and prepared for coloring.

The leather can also be colored after washing, fat-liquoring being done afterwards. Coloring is most expeditiously effected in a drum.

An excellent color is secured by using the following process :

For each hundred pounds of leather ready to be colored, boil in ten gallons of water, one and a half pounds of logwood crystals and four ounces of borax; then stir into the liquor four ounces of fustic paste. Use this liquor at 125 degrees Fahr. Drum the leather in it for one-half hour; then pour into the drum a solution of five ounces of titanium-potassium oxalate in a pail of hot water, and run the drum fifteen minutes longer. If the leather has not been fat-liquored, it should next be washed and then fat-liquored, oiled and dried. The grain should be well struck out and oiled with a mixture of one part olive and three parts paraffine oils. Drying should be done somewhat slowly; and when dry, the leather should be dampened and staked and tacked.

Finishing is done in the same manner as upon straight chrome leather. The grain is given a coat of seasoning, dried and glazed; then given another coat, and dried and glazed again. If grained leather is wanted, the leather after it has been glazed the first time, is grained two ways, from neck to butt and from side to side. A light coat of seasoning is then put on, when it is glazed again and then re-grained. When finished, it very closely resembles genuine chrome leather.

PATENT TIPPING FROM INDIA-TANNED KIPS.

India-tanned kips when properly retanned and fat-liquored

make a very good grade of patent tipping. The kips are taken from the bale and split into sides; they are then dampened and placed in piles until the next day. The grain is then split off at a two and a half or three ounce weight. Washing to prepare the grains for retanning is the next process. Use water at 85 degrees Fahr., and wash them in it in a drum for forty-five minutes; then drain the water out and put in the retanning liquor.

Gambier and hemlock make a good retannage. Prepare a 20-degree barkometer liquor and use three gallons of the same for every dozen sides. Drum the leather in this for thirty minutes. Other good retanning liquors are made of quebracho three parts and palmetto one part; also hemlock and palmetto.

After the sides are retanned, place them in a pile until the next day; then hang them up to dry. When dry have them degreased. Degreasing is for the purpose of removing the peculiar grease in India-tanned leather that cannot be got rid of by washing and that makes it impossible to japan the leather.

For a fat liquor use good moellon degreas. Add three or four ounces of salts of tartar to three gallons of hot water, at 125 degrees Fahr., then stir in three pounds of degreas. Stir thoroughly and run the leather in the fat-liquor thirty minutes. This amount of fat-liquor is for fifty sides. After fat-liquoring, set the leather out on the grain and tack it on frames to dry. When dry, buff off the grain and stake lightly and it is then ready for the japan shop. If no fat-liquor is given, the leather will be dry and tender. There is no danger in using good moellon degreas since all bark tipping, carriage and furniture leathers are stuffed with it.

SECTION FIVE.

THE MANUFACTURE OF GOATSKIN LEATHER.

GOATSKINS with the hair on them are received by the tanner in dry and dry-salted condition. The first process through which they are passed is soaking, which removes from them the dirt, blood and salt, and makes them soft and supple. All the salt on the dry-salted skins must be removed by soaking and washing before they are put into lime. Dry skins must be softened and the shriveled grain freshened and soaked out smooth and clean.

Borax and sulphide of sodium are useful in soaking and softening the skins. As soon as they become soft, they should be put into a drum supplied with running water and run therein until perfectly clean and soft, when they are ready to be put into the lime. Skins that have been pulled off the animal must be cut open after they are soaked; and all skins should be trimmed before they are limed.

Lime and red arsenic are used to loosen the hair and to dissolve the animal matter that must be washed and worked out before soft glazed leather can be made. Lime attacks the tissue of the skins before it acts upon the hair. Red arsenic attacks the hair first. Through the use of both materials, the hair is soon loosened and enough skin substance is dissolved to make soft leather. Red arsenic has a tendency to keep the grain from rising and to keep the skins flat. It is especially useful on skins that are to be glazed since they glaze more brightly than those on which red arsenic has not been used. Lime alone, especially when a fresh solution is used, makes the grain harsh and coarse. For this reason old lime liquor, provided it is clean, produces the best results. Nearly all goatskins for glazed kid are limed in old,

mellow arsenic limes. Such liming, followed by a bating with a bacterial bate, produces the soft, supple leather and the smooth, silky grain that is so much admired. A newly made lime-liquor should always contain some old lime liquor to tone down its harsh effect upon the skins. After the hair becomes loosened it is advisable to leave the skins in the lime a day or two longer as this not only enables the hair to come off more readily but makes the leather more supple. They should then be placed in warm water containing borax which removes surface lime and softens the grain so that the short hairs are easily removed as well as the scurf. The liming is done most satisfactorily by starting the skins in a rather weak and mellow lime, then increasing the strength of the liquor until the hair can be easily removed. It has been proved in practice that by dissolving red arsenic with the hot lime while the latter is slaking, better results are obtained than by dissolving the arsenic by itself. After the skins are unhaired, they are washed and fine-haired, and are in condition to be delimed.

A practical method of liming goatskins consists in weighing them before they are put into lime and figuring the amount of lime and arsenic on the weight at that time. A vat six feet deep should be filled with two and one-half feet of used or old lime liquor and two feet of cold water. Into a tub one-eighth of the weight of the skins of lime and one per cent. of the weight of the skins of red arsenic are placed, and ten or twelve pails of hot water added, the lime and arsenic being stirred until entirely dissolved. About five pails of cold water are added to the lime solution, which is then poured into the vat. The liquor in the vat is then plunged thoroughly and the skins are thrown in. They are hauled out every day and allowed to drain off before being put back, or if a paddle-vat is used, which is preferable, they are stirred about by the paddles and hauling-out is not necessary. The man in charge must be able to determine how much lime and arsenic to add to the liquor. If, on the third day, the hair begins to loosen well, one-fifth of the weight of the skins of lime should be

added; if the hair does not loosen well, more lime than one-fifth must be used. No exact rule can be followed, as the liming depends upon the season of the year and the condition of the skins, some kinds requiring more lime than others. From five to seven days is usually sufficiently long for liming. When the hair can be easily removed the skins are taken out of the lime and unhaired.

New Process for Liming Goatskins.—Besides the old method of unhairing goatskins with lime and red arsenic, there is a new patented process in use that produces superior leather, and also has other advantages. Briefly stated, the process consists of first painting the skins with a thin paste of lime and arsenic and unhairing them after twenty-four hours.

They are then treated in a drum with a solution of sulphide of sodium for about twenty-four hours. Without washing, they are next placed in a reel and subjected to the action of a solution of hyposulphite of soda for about twenty-four hours. After the hyposulphite treatment, they are placed in a vat containing lime, a little arsenic and water, where they remain from two to five days, more or less, after which they are washed, bated and drenched as ordinary limed skins.

This process is said to produce very fine leather, firm and yet soft, and having a very clear and beautiful grain. The patents covering this process are owned by the International Sulphide Process Co., Delaware and Penn Sts., Camden, N. J.

Bating.—The next step in the manufacture of goat leather is the process commonly called bating, by means of which the skins are freed from all lime, arsenic and alkaline sulphide acquired during the previous process of liming, and are made soft and clean and thus put into good condition to be pickled and tanned.

The essential qualities of goatskin leather are softness, elasticity, and smooth, soft and silky grain. These qualities are produced by the methods that are followed in liming and the material and methods that are used in bating and drenching

the skins. They are limed thoroughly and long and then bated in such a manner that not only is the lime entirely removed but also the portion of skin-substance that the lime dissolved, thus permitting the fibers to work readily over each other and the leather to be soft and elastic.

To accomplish the results of the bating process, hen, pigeon and dog dung have been used for many years. While their use is unpleasant and attended by risks and uncertainty, they produce upon the hard-grained goatskins results that cannot be obtained from the use of other materials and they continue to be employed in spite of attempts to displace them with other articles.

Bird dung is very rapid in its action and makes the skins soft and silky, but somewhat firm and lacking in elasticity. Dog dung has a great softening effect upon the skins, and unless it is carefully used, makes the leather hollow and flat and with a great deal of spring to it. Chicken droppings, to which some dog manure has been added, is better than either material used alone. The best results are obtained when the material is gathered while it is fresh and before it has been frozen, and dried for future use. The efficacy of the manure bate depends upon the fermentative action developed.

To prepare a chicken manure bate, put the material to soak in hot water three or four days before it is to be used. Water in a barrel or tub should be heated with steam to 140 degrees Fahr., the dry material put into the water and stirred once or twice each day so as to get it into a sort of mash that can be easily worked through a strainer before it is used. It is always advisable to strain the manure before use to get out all stones, feathers, etc. A wire strainer having wire $\frac{1}{4}$ -inch mesh, fitted over a barrel, answers the purpose.

When the skins are to be bated, fill the paddle vat with water and warm it up to 90 degrees Fahr. Add to the warm water one bushel of the strained manure for every one hundred large goatskins or two hundred small ones. Plunge the bate liquor very thoroughly and then throw the skins in as quickly as pos-

sible. If the bating is to be done during the night, run the paddle one hour before stopping for the night. The next morning run the paddle again for one hour, at the end of which time the skins should have been reduced from the plump, limey condition to one of softness and thinness and the grain should have a smooth, silky feel. No specific rule can be followed. The man in charge must use his judgment in determining when the skins are sufficiently bated. Sometimes it is necessary to warm the bate again, and occasionally the addition of more bating material is required. Heavy, coarse skins naturally require more bate and longer treatment than light ones. Some classes of goatskins also bate more rapidly than others. When the bating is done during the day, the paddle should be run one hour, then stopped, and run one-half hour at a time at intervals of thirty minutes until the skins are low and soft.

A common way to determine when the skins are bated is to take one of them, double it over, take the edge between the thumb and first finger and press hard. If the pinched edge remains sharply defined the skin is bated. A little experience will soon teach the operator to determine when the bating is accomplished.

The most satisfactory apparatus for bating is a covered paddle wheel, in which there is a steam pipe with a box around it so that the liquor can be warmed while the skins are in it. The box surrounding the pipe should have a number of one-inch holes in it, and the steam pipe should have a bend. to correspond with the curve of the round bottom of the tub. There should also be a door in the front end of the cover which can be raised when putting in or taking out skins. With a paddle tub fitted up in this way very uniform bating can be done. The skins can be put into a cold bating liquor, the steam turned on, and, without burning them, the liquor can be warmed up to 90 degrees Fahr., and they will all be of the same temperature and will bate uniformly in the warm bate.

It is not an infrequent occurrence for skins to be seriously injured while they are being bated. The liquor sometimes putrefies, and when this happens the flesh and grain peel off, the skins become discolored, and when tanned and finished show serious defects. By giving close attention to the work, trouble is less apt to occur and the skins can be safely prepared for tanning.

After the bating process is completed, the skins should be thoroughly worked out on the grain and all filth and slime forced out of the pores. When this has been done, they are placed in a weak lactic acid bath made in the proportions of two quarts of lactic acid to each hundred gallons of warm water. They are drenched in this bath for thirty minutes and are then ready to be pickled.

The cleaner the skins are, the more readily they tan and the better are the results of coloring and finishing. A point to be observed during bating and washing is that the temperature of the liquors used should never be higher than 95 degrees Fahr. The use of liquor or water warmer than this burns the skins, shrinks them and makes the grain harsh and coarse. Drenching after bating may be done in a bran drench, but this has no advantage over the lactic acid drench and is less easily prepared.

Bating with Formic and Lactic Acids.—These acids remove lime from skins in a short time, but they do not produce the soft and silky grain, which can only be obtained by using a bacterial bate. The skins can, however, be partially bated with manure and then transferred to a bath of formic and lactic acids, wherein they are entirely delimed. In the manure bate the skins may remain for three-quarters of an hour, or until they begin to fall and the flesh begins to slip slightly. They should then be scudded or worked out on the grain and next placed in a weak, warm bath of the two acids named. The acids, four parts formic and one part lactic, should be mixed and half a pint or less of the mixed acids should be added to sufficient water at 90 degrees Fahr. to cover one hundred

dozen skins, three pounds of calcium chloride being then added to the drench. The skins are thrown in and paddled one-half hour, then washed in warm water and pickled.

Bating with Puerine.—Puerine is a bacterial bate that is used in place of manure. It produces excellent results and is very uniform, clean and safe. It contains no foreign matter, and the bateman can tell just how many pounds to use to bate a pack of skins. No subsequent drenching is required, which is an advantage. Directions for using Puerine are furnished by the manufacturers, The Martin Dennis Company, Newark, New Jersey.

Pickling with Acid and Salt.—The object of pickling is to prepare the skins for tanning, to bleach, and to preserve them. It is done in a paddle-wheel in this manner: To every hundred gallons of water in the paddle-wheel, forty pounds of salt are added. Then for each hundred pounds of skins, weighed after drenching and draining, ten pounds of salt and one and one-half pounds of sulphuric acid are added to the salt water, and the liquor is then very thoroughly plunged. The skins are thrown in while the paddle is running and are left in the liquor for two hours, after which they are placed smoothly over a horse and drained for twelve hours; they are then in condition to be tanned.

BEAMHOUSE PROCESS FOR CABRETTA SKINS.

In order to get the best results in the tanning of cabretta skins, the tanner should use the sulphide of sodium process in preparing them, then tan them with a chrome process, and finish the same as goatskins.

Soak the skins until they are soft and clean, then let them drain a few hours. Prepare a solution of sulphide of sodium of about 18 degrees Baumé strength and paint it upon the flesh sides. As soon as a skin is painted, fold it from neck to butt, hair side out, and place it in a pile with five or six others, and let them lie until the next day, when the hair can be easily removed over the beam. A mixture of sulphide of sodium

and slaked lime may be used to remove the hair in precisely the same manner as such a liquor is used on sheepskins.

After the hair has been removed, the skins are ready for further treatment with sulphide of sodium. Dissolve thirteen pounds of sulphide of sodium with hot water in a barrel, place the skins in a revolving drum, add ten pails of cold water to the sulphide liquor to cool it, put it into the drum and drum the skins in the liquor for two or three hours. The quantity of sulphide of sodium stated is enough for ten dozen skins.

When the skins have been drummed in the sulphide of sodium liquor for two or three hours, the drum should be stopped and the skins allowed to remain in the liquor over night. The next morning take them out of the liquor and wash them in warm water to get rid of the short hair which has been reduced to a slimy mass. Then put them into a drum together with a solution of bicarbonate of soda made by dissolving three pounds of the soda in twelve gallons of water at 85 degrees Fahr. for each hundred pounds of skins, and drum them in this solution for forty minutes, then wash them for a half-hour in a paddle wheel, when they are ready to be drenched. By this method the hair is saved in good condition, the cost of handling the stock is less than when any other process is used and, most important of all, the skins are made plumper and tougher than when they are limed and bated in the old way.

Drenching may be done with one pint of lactic acid for each hundred pounds of skins, and by thorough washing before drenching, the quantity of acid may be reduced to one and a half pints for every two hundred pounds. Or the skins can be drenched in a bran drench or in a drench of bran and lactic acid as described for sheepskins. If the tanner does not care for the hair he can use this process: Dissolve sulphide of sodium in water and pour enough of the solution into a vat until the liquor in the latter is $1\frac{1}{2}$ degrees Baumé test. Put the skins into this solution and by means of the paddle stir them about, allowing them to remain two days, then wash them as directed above.

After the skins have been drenched and worked out, pickle them. Use three quarts of sulphuric acid and seventy-five pounds of salt for one hundred and fifty skins, with water enough to cover them. Stir them in the pickle three hours, then let them drain and when well drained tan them in a chrome process, and finish the same as goatskins.

PROCESS OF TANNING GOATSKINS.

Nearly all goatskins are tanned at the present time by some method of chrome tanning, both the two-bath and one-bath processes being used. Several methods of tanning will be described. The original and most commonly used two-bath process consists of two acid baths, the first consisting of chromic acid formed by the combination of bichromate of potash and muriatic or sulphuric acid, and the second bath of sulphurous acid evolved from the union of hyposulphite of soda and muriatic acid. A practical method of tanning goatskins with this process is carried out in the following manner:

The pickled skins are taken and weighed. For every hundred pounds of them in the lot to be tanned, five pounds of bichromate of potash are dissolved in three gallons of water, and to the solution are added four pounds of muriatic acid. The skins are thrown into a tanning drum together with eight pounds of salt and twelve gallons of water for one hundred pounds of them. The drum is started, and the solution of bichromate of potash and acid is poured into it through the funnel and hollow axle with which the drum is equipped. The skins are drummed in the liquor until the thickest part of the heaviest one shows thorough penetration, which takes from one to three hours. The liquor penetrates rapidly, but the skins should not be hurried, but drummed as long as stated to accomplish a thorough tanning. They are then taken out of the drum and placed smoothly over horses and left thereon for twenty-four hours; they are next run through a putting-out machine, or are struck out by hand to remove all wrinkles and to insure a smooth grain. After they are struck out, they are in condition to receive the second liquor.

The second bath is prepared by dissolving fourteen pounds of hyposulphite of soda in ten gallons of boiling water for one hundred pounds of skins, five or six gallons of cold water being added to cool the solution, which should not be used until it has become cold. Into a wooden pail full of water four pounds of muriatic acid are stirred. The skins are put into the drum together with the solution of hyposulphite of soda, and as soon as the drum is started, the muriatic acid solution is poured through the funnel into the drum. The latter should always be running while the acid is being added to its contents, and should be kept going for at least one hour afterwards. The drumming should be continued until the skins have assumed a uniform blue color, and all trace of yellow has disappeared from the interior of them. The tanning is then completed; the skins are removed from the drum and placed over horses to drain.

Skins are also tanned by using five pounds of bichromate of potash and two and one-half pounds of sulphuric acid in ten gallons of water for the first bath, and eighteen pounds of hyposulphite of soda and four pounds of muriatic acid in fifteen gallons of water for the second bath. On close, fine-pored skins more material is required than on open-pored ones.

Salt is an important factor in this process, and a sufficient quantity should always be used to control the action of the acid. When more acid than is necessary to form chromic acid is used, the salt protects the skins and prevents the acid from doing harm.

Bisulphite of soda is sometimes used in the second bath in place of hyposulphite; the latter, however, is in most common use. Muriatic acid is always employed in the second bath, as there is less danger of sulphur being precipitated on the fibers than with sulphuric acid. The harder the skins are struck out from the first bath, the less chromic acid they contain and the less hyposulphite of soda is required to reduce it to chromic oxide. As a general rule twelve pounds of hyposulphite of soda and three pounds of acid are sufficient for one hundred pounds of skins. Heavy stock requires more soda, from twelve

to eighteen pounds being used, with more acid to correspond. The skins should be given plenty of time during the process and afterwards.

The workmen who handle the skins out of the first bath should wear rubber gloves for protection from the poisonous chrome liquor, which causes serious sores when handled with unprotected hands.

While the skins are draining from the first liquor they should be kept in a dark place or else well covered up; they must never be exposed to the effect of the light. If exposed to the light for any length of time, or are allowed to dry or harden, the chromic acid is reduced to chromic oxide at their expense. The reduction should take place in the second bath.

Bichromate of soda may be used in place of bichromate of potash in the first bath. The chromic acid, which is formed by the addition of muriatic acid to a solution of bichromate of potash or of soda, is absorbed by the skins, which do not undergo any chemical change. In the second bath the acidified solution of hyposulphite of soda reduces the chromic acid to chromic oxide, thus tanning the skins. In addition to the insoluble basic chrome salts, sulphur is deposited on the fibers. It is not a simple matter to obtain a uniform quality of leather, as the process is more intricate than it appears to be; complicated reactions take place, and free sulphur is liberated in the skins which is removed with considerable difficulty. Tanning with this process is also done in paddle-vats; also by giving the first bath in a drum and the second bath in a paddle-vat.

After the skins have drained several hours they are very thoroughly washed. They are first washed in warm water containing borax, and then in clear water until all traces of acid and tanning materials are removed.

A good washing process consists of two baths, the first, a solution of two to three per cent. of the weight of the skins of sodium phosphate, and the second, a solution of 0.5 per cent. of sodium bicarbonate. The temperature of the baths should be 80 degrees Fahr. In the first bath the skins are washed from

twenty to forty minutes; the liquor is then drained off and the second solution is put in, and washing continued thirty minutes longer. This washing accomplishes the neutralization of the skins. Some tanners merely wash the skins in hot water, using a twister, which accomplishes the process in less time than either an ordinary drum or a paddle-vat.

One of the most essential qualities of goatskin leather is a smooth, fine grain. A method of acid tanning considerably different from the regular two-bath process produces a smoother grain with less contraction because no sulphur is present in the second bath. While this method partakes to some extent of the nature of the original two-bath process, it is really a one-bath one, as will be seen from the following description.

Four pounds of bichromate of potash are used for each hundred pounds of skins to be tanned. This quantity of potash is dissolved in boiling water and mixed with three pounds of muriatic acid of a strength of 20 degrees Bé. The solution is then added to sufficient water in a vat to cover the skins.

The skins are treated in this solution for a period of time long enough to enable the yellow liquor to penetrate the thickest one. Without removing them from this chrome liquor, two solutions—called the S. Z. solution and the S. K. solution—are added, in the proportion of twenty per cent. of the former and thirty-five per cent. of the latter. These two solutions should be well mixed together before being given to the skins. After the two solutions have been mixed and added to the chrome liquor, five per cent. of the weight of the skins of sulphuric acid is mixed with about thirty times its weight of water, and added to the bath. To prevent the acid from coming in direct contact with the skins, it should be added to the bath through a lead-lined funnel long enough to reach to the bottom of the vat. While these liquors are being added the drum should be kept in constant motion. At the end of one and one-half days the tanning is done, although the skins may be left for a longer time in the liquor without injury. No contraction of the fibers results when this process is used, and no sulphur is present as in the older chrome process.

The S. Z. solution consists of eighty pounds of nitrite of soda dissolved in eighty-four pounds of hot water. The S. K. solution is composed of forty-eight pounds of fresh chloride of lime, forty-eight pounds of soda-ash and three hundred and eighty-four pounds of hot water. The soda-ash is first dissolved in the hot water, and when it is all dissolved the chloride of lime is added through a sieve. While this is being done the liquor should be constantly stirred. When all the lime has been stirred in, the liquor is allowed to rest for two days, until all the sediment has settled to the bottom of the vessel. The clear liquor is drawn off and used in the process, while the sediment is thrown away. Both liquors, S. Z. and S. K., may be kept in one vessel, carboy, vat, or hogshead, provided the proper proportions are kept up; when it is wanted the required quantity is taken out for use. A wooden tank, tub, or hogshead should be used for making the solutions.

The inventor of the method that has just been described is also the discoverer of the following process, upon which he has been granted a patent: For each hundred pounds of skins as they come from the beam-house, drained after the final washing, four pounds of bichromate of potash and three pounds of muriatic acid of a strength of 20 degrees Bé. are mingled with the quantity of water necessary to drum the skins in. In this liquor they are drummed until thoroughly impregnated with the liquor; then they are removed from the drum, drained or pressed or struck out, and are then ready for the second bath. For this one hundred gallons of water are heated to a temperature of about ninety degrees Fahr. Into this are poured five pounds and five ounces of sulphuric acid of a strength of 66 degrees Bé. This is well mixed through the water, and then are added, by being slowly sifted in, four pounds of peroxide of sodium. While this is being done, the liquor should be constantly stirred. When all the peroxide of sodium has been added, the previously-chromed skins are entered into the liquor and paddled until they are tanned, which can be readily seen by the tanner. In this process no

sulphurous acid is evolved. The grain of the skins is left smooth and adapted to readily receive a glazed or enameled finish.

Tanning with One-Bath Processes.—There are commercial one-bath tanning liquors and crystals on the market that the tanner can buy. They are more uniform than any liquor the tanner can make, and are cheaper. They come in concentrated form, requiring only to be reduced with water and applied to the skins.

The pickled skins can be tanned with one-bath material by carrying out the following instructions: For every hundred pounds of them dissolve one pound of Glauber salt in eight gallons of water. Mill them in this solution fifteen minutes. They should then be thrown back upon each side of the drum, the plug pulled out, and the liquor allowed to run off. Replace the plug in the drum, and for each one hundred pounds of skins put ten pounds of common salt and eight gallons of water into the drum and run the latter five minutes. In the meantime dissolve ten to twelve pounds of concentrated chrome liquor for each hundred pounds of skins in four gallons of warm water. Give the skins one-fourth of this chrome liquor and run the drum twenty minutes. Then pour into the drum another quarter of the liquor and drum one-half hour. The third portion should then be put into the drum, and after thirty minutes the last portion, and the drumming continued for two or three hours. In a little hot water now dissolve eight ounces of bicarbonate of soda for each hundred pounds of skins, add this to the contents of the drum and run the latter one-half hour. If at the end of this time the liquor in the drum is still of a deep green color, add another half pound of the soda and drum thirty minutes longer. The skins should be left in the liquor over night, sufficient water being added to it to cover them. Remove the leather from the drum and allow it to drain for twenty-four hours before washing it. After it has been pressed and drained twenty-four hours, wash it in a two per cent. solution of borax

for one-half hour, then in clean water for twenty minutes, when it is sufficiently washed to be shaved, colored, fat-liquored, dried and finished.

The tanning material can be prepared for use by reducing the concentrated liquor with warm water until the solution is 23 degrees Baumé scale. Four gallons of such liquor will tan one hundred pounds of skins.

Tanning with Sulphate of Alumina, Sal Soda and Chrome Liquor.—Pickled skins are also tanned by the following process: They are weighed and for each one hundred pounds to be tanned two solutions are prepared, one consisting of three pounds of sulphate of alumina in five gallons of water, and the other, of three pounds of sal soda also in five gallons of water. Both materials are separately boiled with steam until dissolved. The solution of sal soda is then slowly stirred into that of sulphate of alumina, a small portion at a time and short intervals allowed for the effervescence to subside. The two solutions combined form a milk-white liquor. This should be allowed to become cool before it is used, or enough cold water may be added to reduce the temperature to 85 degrees Fahr. The skins are thrown into the drum with eight pounds of salt and five gallons of water and drummed therein ten minutes; then the alumina-soda liquor is poured into the drum, and drumming is continued for thirty minutes.

Four gallons of one-bath chrome liquor, in portions of a gallon at a time, are poured into the drum and the latter is run until the skins are fully tanned. One-half pound of salts of tartar is then dissolved and added to the contents of the drum and after another half hour drumming the process is completed. The skins should be allowed to press and drain for twenty-four hours, next be washed in a one per cent. solution of borax for thirty minutes and finally in clean water for forty minutes, after which they are pressed or struck out, shaved, colored, fat-liquored and dried out.

Tanning with Sulphate of Alumina and Chrome Liquor.—For this process of tanning the acid pickle should be removed

by drenching the skins in a drench of sour bran and salt. Then for each hundred pounds of stock prepare a solution by dissolving three pounds of sulphate of alumina and eight pounds of salt in eight gallons of lukewarm water. Run the skins in this solution for forty minutes. Then add chrome-liquor in portions of a gallon at a time until three or four gallons have been poured into the drum. Allow the drum to revolve three hours or longer; then let the skins remain in the liquor overnight. The next morning place them smoothly over a horse and let them drain for twenty-four hours. The next process is washing, after which they are shaved, colored and finished.

Sometimes it is deemed expedient to keep skins for some time after they are bated. This can be done by treating them with alum or sulphate of alumina and salt, after which they can be kept a long time without spoiling as the alum and salt virtually tans them. The solution of alum and salt is made by dissolving three or four pounds of alum and six or eight pounds of salt in ten gallons of water for one hundred pounds of skins taken after bating and drenching, or after the acid pickle has been removed from them. When taken after bating and drenching, no acid pickle is used. The skins are drummed in the alum and salt solution forty-five minutes, then placed over horses to drain and finally rolled up in bundles or packed in barrels and put away until they are to be tanned.

When they are to be tanned, they are put into the tanning drum with a solution of chrome liquor and processed therein until tanned. Ten or twelve pounds of concentrated chrome liquor dissolved in a few gallons of water tans one hundred pounds of alum-pickled skins.

To wash the tanned skins use one pound of borax and fifteen gallons of water. Wash them in this liquor for twenty minutes; then remove the plugs, turn on running water and continue washing thirty minutes longer. After they are washed, press or strike them out, and then shave them.

METHODS OF DYEING GOATSKINS BLACK.

Dyeing with Logwood and Titanium Salt.—For one hundred pounds of shaved skins use:

Logwood Crystals.....	1½ pounds.
Extract of Fustic Paste	4 ounces.
Salts of Tartar	3 ounces.

Boil the logwood in six gallons of water until dissolved; then add the fustic paste and stir thoroughly; run in enough cold water to make twelve gallons of liquor; add the salts of tartar and then color the skins by drumming them in the dye for twenty minutes until the logwood is taken up. The temperature of the liquor should be 120 degrees Fahr. Borax may be used in place of salts of tartar. While the skins are running in the dye, dissolve in a pail of hot water, for each hundred pounds of skins,

Titanium-Potassium Oxalate	6 ounces.
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When the twenty minutes are up, pour this solution into the drum and drum the skins ten or fifteen minutes longer. Then wash them in warm water and fat-liquor them.

Dyeing with Logwood and Bichromate of Potash.—Prepare a logwood-fustic liquor as directed above and run the skins in it for twenty minutes. Then in a pail of water dissolve,

Bichromate of Potash.....	1 ounce,
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and when the twenty minutes are up, add this solution to the contents of the drum and run the drum ten or fifteen minutes longer. Wash and fat-liquor the skins.

Dyeing with Logwood, Acetic Acid and Nitrate of Iron.—To color one hundred pounds of skins use:

Logwood Crystals.....	1½ pounds.
Black Nigrosine	1 ounce.
Borax	4 ounces.
Acetic Acid.....	1½ ounces.
Nitrate of Iron	3 ounces.

Boil the logwood in a few gallons of water; add the borax and enough water to make twelve gallons of liquor. In a pail of hot water dissolve the nigrosine. Run the skins in the logwood liquor for ten minutes; add the nigrosine and run ten

minutes longer. Then dissolve the acetic acid and nitrate of iron in two gallons of water. Pour the solution into the drum and run the latter fifteen minutes. Then drain the liquor out of the drum, wash the skins in two or three changes of water and then fat-liquor them. The temperature of the dye liquor should be 120 degrees Fahr.

Dyeing with Logwood, Permanganate of Potash, and Iron Liquor.—A process of dyeing chrome goatskins in which permanganate of potash is used was recently patented by William M. Norris, of Princeton, New Jersey. The process is applied in the following manner: In the drum are placed four hundred and fifty pounds of skins as they come from the shaving machine and thirty gallons of water at a temperature of from 110 to 120 degrees Fahr., and the drum is then closed and started. Now dissolve two and one-half pounds of permanganate of potash in forty-five gallons of warm water and then add two and one-half pounds of muriatic acid of 21 degrees Baumé, this solution being run into the drum through the hollow gudgeon. After ten minutes, stop the rotation of the drum, then open it and allow the liquor, which is now spent, to run off. Replace the head or door of the drum, allow the latter to rotate and add as before through the gudgeon, two gallons of iron liquor which have been previously mixed with forty-five gallons of warm water. After ten minutes, stop the rotation of the drum, open it and allow the liquor to run off. Next dissolve in forty-five gallons of warm water, three pounds of extract of logwood and three pounds of sal soda; and after the drum has been closed and allowed to rotate, add the liquor through the gudgeon. After ten minutes, stop the drum and remove the skins. The coloring process is now complete, and the skins are thoroughly washed in a twister with warm water for fifteen or twenty minutes before being fat-liquored and finished.

The iron liquor referred to may be prepared by dissolving scrap iron in dilute commercial acetic acid; the solution ready for use should stand 10 degrees on a Baumé hydrometer. But any suitable ferrous salt of iron may be used. The tem-

perature of the warm water referred to should be about 110 degrees Fahr. in summer, and from 120 degrees to 125 degrees Fahr. in winter.

The muriatic acid should always be added to the permanganate solution when all the required amount of water is present, and never to a hot concentrated solution of permanganate of potash.

It is claimed that deep, rich and more permanent shades of black besides other advantages can be economically obtained by the use of this process.

Dyeing with Logwood and Copperas.—For each one hundred pounds of skins to be dyed prepare a logwood liquor by boiling in a few gallons of water:

Logwood Crystals.....	1½ pounds.
Fustic Paste	4 ounces.
Borax	4 ounces.

Drum the skins in this liquor, of which there should be twelve gallons at 120 degrees Fahr., for twenty minutes. In the meantime, dissolve in three gallons of boiling water:

Copperas.....	2 ounces.
Bluestone	½ ounce.

Add cold water to the solution to reduce the temperature to 100 degrees Fahr. When the twenty minutes are up, pour the solution into the drum and allow the latter to rotate fifteen minutes. Then remove the skins from the drum, wash them in two or three changes of warm water and finally fat-liquor them.

PROCESSES OF COLORING CHROME-TANNED GOATSKINS.

Chrome-tanned goatskins are readily colored any shade with aniline and alizarine dyes, provided they are first properly prepared to receive the dye, and the right materials and methods are used in the coloring operations. The most common method of coloring with aniline dyes is to mordant the skins with tanning extracts such as sumac, gambier, palmetto, fustic, and the like. Alizarine dyes require no mordant as they dye directly on the chrome-tanned leather.

Before any attempt is made to color the skins, however, it is very essential that they be thoroughly washed in order to rid them of all acids and salts acquired during the process of tanning. This washing should never be omitted or slighted with acid-tanned stock. When the skins are not pickled before tanning and when they are tanned with sulphate of alumina and a one-bath chrome liquor or with the latter alone, they can be colored, fat-liquored and dried and then washed, and the result is very soft, glove-like leather; but acid-tanned and one-bath tanned stock for shoe leather should always be washed before being colored.

After the skins are washed, they are struck out by hand or machine or pressed and are then shaved and made of more uniform thickness and smooth and clean on the flesh side. During the operations of washing, striking-out and shaving, they should be kept from contact with stain and grease, which are readily absorbed by them at this stage of the work and interfere with the subsequent coloring and finishing.

The tanning materials that are used as mordants frequently contain gummy matter which causes spots to appear upon the leather. To avoid this, it is a wise precaution to strain the solution before using it. The materials should be boiled until dissolved; then enough water should be added to make twelve gallons of solution for one hundred pounds of skins. Coloring is done most uniformly and expeditiously in a drum.

The temperature of the solutions used in coloring should be from 100 to 125 degrees Fahr. There is less liability of the color fading if fat-liquoring is done immediately after coloring. After the skins have been drummed in the mordant, the liquor should be run out of the drum, the latter closed and started again, and the dye liquor added through the funnel and hollow gudgeon while the drum is running. The drum should now be stopped until the color solution has been in at least ten minutes or the skins will be spotted. The aniline dye should be dissolved in clean boiling water and then boiled thoroughly. When it is completely dissolved, it is best

to strain the solution through cheese cloth into another pail, then to cool it with cold water to the proper temperature. It is, of course, necessary to keep the pails and drums used in coloring as clean as possible. These points carefully observed assist materially in getting satisfactory colors. The skins can be fat-liquored either before or after they are colored. The most common practice is to fat-liquor after coloring, although good results are obtained when the skins are fat-liquored, then mordanted and colored or first mordanted, then fat-liquored and colored.

Sumac Mordant.—The tanning material most commonly used in coloring chrome leather is sumac. This material, because of the small amount of coloring matter it contains, is naturally adapted to the production of light and fancy shades. It is used in various ways. A practical way to color the skins with extract of sumac and aniline dye is carried out according to the following instructions:

Prepare a sumac liquor by using four ounces of extract of sumac for each dozen skins, or from one to two pounds for one hundred pounds of leather. Have the temperature of the liquor about 100 degrees Fahr., and drum the skins in it twenty minutes. Then add to the sumac liquor in the drum four ounces of titanium-potassium oxalate dissolved in a pail of hot water for each one hundred pounds of skins. Run the drum ten minutes, then drain the liquor out of it and run in the aniline solution to color. This process of coloring produces full, clear and uniform colors with either basic or acid dyes, preferably the latter.

Gambier Mordant.—For one hundred pounds of stock use two pounds of gambier dissolved in twelve gallons of water. Use at a temperature of 100 degrees Fahr., and drum the skins in the solution forty minutes. Then pour into the drum four ounces of titanium salt dissolved in hot water. Run the drum ten minutes longer. Then drain out the liquor and color the skins with acid dye or rinse them in warm water and color with basic dye. This is a good process for tan shades.

A liquor composed of equal parts of gambier and fustic is also an excellent mordant for shades of tan and light brown.

Fustic Mordant.—Fustic extract is frequently used as a base or mordant for aniline dyes on chrome-tanned goatskins. Five ounces of liquid extract used for each dozen skins, or from one to two pounds for one hundred pounds of them, produce good results. It is used for both light and dark shades. After the skins have been drummed in it, a solution of titanium salt should be added and the drumming continued ten minutes, the liquor then run off and the skins colored with aniline dye.

Palmetto Mordant.—Very good coloring is obtained from the use of palmetto extract as a mordant. This material is a good fastener of aniline dye, and by its use the grain is made solid and smooth and less liable to peel. It also neutralizes any acid in the skins. About five ounces of the extract may be used at a temperature of 110 degrees Fahr. for each dozen skins, or from one to two pounds for one hundred pounds of leather. Treatment with titanium salt is the same as upon sumac and gambier mordant.

Other Mordants.—In addition to the extracts that have been mentioned, quermos, hemlock, quebracho and various combinations of extracts are used. The object of using them is to impart tannin to the skins, which serves as a mordant for the dye. "When titanium salts are applied to chrome leather lightly treated with some tannin, the titanium unites with the tannin of the leather to form a yellowish-brown titanium tannate, which combines with the fiber of the leather, and which is fast and stable and brings up subsequent colors in a remarkable way. And, therefore, the leather in addition to being mordanted with the better mordant in preparation for the subsequent dyeing, is already, without any dye, given the yellow base necessary when all shades except lilac, gray and purple tones are wanted. All shades of yellow, tan, brown, green, red, maroon, and of dark blue, are thus ready for the dyeing to shade."

Clearing the Grain of Grease.—Goatskins that have greasy

grain may be cleared by being drummed in a solution of lactic acid, made by adding one gallon of the acid to fifty gallons of water at 110 degrees Fahr. In this solution the skins are drummed for twenty minutes; they are then washed and treated with sumac or other extract and colored. The acid solution not only removes surface grease but also opens up the grain a little, thus allowing the mordant and dye to go on more deeply and more uniformly. Too much vegetable tanning material gives the skins the appearance of vegetable-tanned leather and of being overtanned, which is considered a defect. Only such a quantity should be used as will serve to mordant the dye, say on light skins, from one to two pounds for one hundred pounds of leather.

DYEING WITH NATURAL DYESTUFFS.

A few practical receipts are here given by which chrome-tanned goatskins can be colored desirable shades without the use of either aniline or alizarine dyes. The cost of dyeing with dyewood extracts is less than with aniline dyes, and faster colors are obtained.

Light Tan.—Take one hundred pounds of shaved skins and put them into a drum together with twelve gallons of water at 125 degrees Fahr. In a clean pail dissolve in hot water two pounds of fustic extract, lemon shade. Start the drum; and then pour into it the solution of fustic extract and drum the skins in it for one-half hour. Then dissolve in hot water and add to the liquor in the drum, four ounces of titanium-potassium oxalate and run the drum fifteen minutes longer. The skins are then colored and should be washed and fat-liquored.

Dark Tan.—Run the skins in a solution of four pounds of fustic extract, red shade, at a temperature of 125 degrees Fahr. for thirty minutes, there being twelve gallons of the liquor for one hundred pounds of skins. When the thirty minutes are up, add to the liquor without stopping the drum, six ounces of titanium salt dissolved in a little hot water. Allow the drum

to rotate fifteen minutes longer; then wash and fat-liquor the skins.

Oxblood Shade.—Dissolve by boiling in a few gallons of water two and one-fourth pounds of hypernic extract, one and one-half ounces of logwood extract and one-half ounce leather red for every hundred pounds of skins to be colored. Add sufficient water to make twelve gallons of liquor and use it at a temperature of 125 degrees Fahr. Drum the skins in this liquor one-half hour. Then dissolve and add to the contents of the drum, four and one-half ounces of titanium-potassium oxalate and allow the drum to rotate fifteen minutes longer. The skins are then ready to be washed and fat-liquored. This process produces a desirable shade of oxblood with less labor and expense than aniline dyes.

Chocolate Brown.—For this shade use two and one-fourth pounds of fustic extract, lemon shade, ten ounces of hypernic extract and three ounces of logwood crystals in twelve gallons of hot water for one hundred pounds of skins. After the latter have been drumming in the liquor one-half hour, pour into the drum five ounces of titanium salt dissolved in hot water. Run the drum fifteen minutes; then wash and fat-liquor the skins.

DYEING WITH ANILINE DYES.

A few receipts are given for some of the shades that are popular at the present time. A desirable shade of tan is obtained by using twelve ounces of phosphine G., three ounces of Bismarck brown, R. S., one-sixteenth ounce new blue and eight ounces of bichromate of potash for two hundred and fifty pounds of skins. Mordant the skins with gambier and fustic and titanium salt; then drain off the liquor, add first the phosphine in solution and drum twenty minutes, then the brown, and run ten minutes, next the blue and run five minutes, and lastly the bichromate of potash and run the drum three minutes longer. Wash and fat-liquor the skins. For an ox-blood shade, use amaranth 3 R and malachite green. Mordant with sumac, fustic or palmetto and titanium salt; then color with

from three to six ounces of amaranth 3 R and from one-eighth to one-fourth of an ounce of green for each dozen skins, according to size. After the skins are colored, wash and fat-liquor them. A correct shade of oxblood may be obtained on two dozen skins, measuring sixty feet to the dozen, by mordanting them with a solution of hypernic extract, prepared by boiling thoroughly ten pounds of hypernic chips and straining the solution and running the skins in it. In place of hypernic chips, solution of fustic, sumac, or palmetto extract may be used, followed by a solution of titanium salt. Then for the two dozen skins use seven ounces of amaranth 3 R, dissolved by boiling and used at a temperature of 120 degrees Fahr.

A desirable chocolate brown is obtained by using three ounces per dozen of chocolate brown 270 applied after a treatment with extract and titanium salt. Leather brown F. when saddened with a little green or blue, also produces a nice dark brown.

The following dyes applied to skins mordanted with fustic and titanium-potassium oxalate produce a rich brown: For one dozen skins, four ounces of phosphine for leather, one-fourth of an ounce of leather green M. and one-half of an ounce of methyl violet 2 B. The dyes should be dissolved and mixed before they are used.

Various shades of brown and tan are obtained by using phosphine G. in conjunction with other dyes, such as greens, blues and purples, in varying proportions.

The Water.—Hard water is unfit for use in leather dyeing. It should be soft and clean. Any water can be made more suitable for the purpose by having a little borax added to it, say one-half pound to one hundred gallons dissolved separately and stirred into it. Condensed steam, which can be collected by placing barrels under exhaust steam pipes, is excellent for use in coloring leather. Hard water should always be softened before it is used.

Coloring after Fat-Liquoring with Sulphonated Oil.—Chrometanned goatskins may be finished into very soft and evenly

colored leather by being washed and shaved after tanning, then fat-liquored with acid fat-liquor and then mordanted and colored. After the skins are fat-liquored, rinse them in warm water, put them into a drum, with a solution of gambier and and fustic or other extract, and drum together one-half hour. Then pour a solution of titanium salt into the drum and run the skins in the combined liquor fifteen minutes longer. Then drain the liquor out of the drum and apply the aniline dye. After the operation is finished, rinse the skins in warm water, strike them out and hang them up to dry. The finished leather will be all that could be desired. The process can also be carried out by applying the mordant first, then fat-liquoring and coloring afterwards.

Although acid-treated oil is most suitable for this process, an emulsion of egg yolk and olive or neatsfoot oil may be used, as it imparts great softness and smoothness without injuring the color or making the leather greasy.

FAT-LIQUORS FOR COLORED AND BLACK GOATSKINS.

In order that the skins may be finished into soft and salable leather, it is necessary to treat them with some sort of oil or grease in order that they may acquire the required qualities of softness and silky feel. The process of fat-liquoring imparts these qualities.

Various emulsions of oil, soap and egg yolk are in use. Nothing can be used, however, that will seriously effect the color or cause the leather to be greasy, sticky or spotted. After the coloring operations are finished, the skins should be washed and struck or pressed to rid them of the surplus water which would retard the penetration of the fat-liquor. A suitable drum is heated with live steam to about 140 degrees Fahr.; whatever water there may be in it is drained out and the skins are thrown in, and drummed for five minutes so as to warm them. The fat-liquor is then added in portions of a gallon or two at a time until the necessary quantity has been given to the skins. The drum should be supplied with a hollow gudgeon or

axle and a funnel attached thereto so that the fat-liquor may be added without stopping the drum. Any excess of water in the skins should be guarded against as it prevents the uniform absorption of the fat-liquor. After the fat-liquor has been applied the skins should be drummed in it for twenty or thirty minutes or longer if they are thick and heavy; they should then be laid in piles or thrown smoothly over horses and covered up for twenty-four hours, so that before they are dried the fat-liquor may combine with the fibers.

Receipt No. 1.—Proportions for one dozen skins:

Conti Castile Soap	4 ounces.
Egg Yolk	1 pint.
Good Olive Oil	$\frac{1}{2}$ pint.
Water	6 gallons.

Chip the soap into the water and boil until it is dissolved; add the oil and stir thoroughly and boil ten minutes. Cool the liquor to 95 degrees Fahr., and add the eggs, stirring thoroughly. This is a good fat-liquor for either fat or colored skins. The quantities of ingredients named are for one dozen small, light skins. Use at 100 degrees Fahr. For very soft leather such as glove skins one pint of flour may be made into a thin paste with cold water and added to the fat-liquor.

Receipt No. 2.—To make fifty gallons of fat-liquor use the following materials:

Palermo Fig Soap.....	10 pounds.
Neatsfoot or Cod Oil	4 gallons.
Egg Yolk.....	10 pounds.
Common Salt	2 pounds.

Put the soap into a clean barrel together with a few gallons of water. Apply steam, and boil and stir the soap until it is dissolved. Take the oil, which should be the best grade obtainable, and cut it by stirring into it a few ounces of borax, potash or sal soda, and add it to the dissolved soap, stirring several minutes until the oil and soap are thoroughly assimilated. Then run into the barrel forty gallons of cold water to cool the emulsion; and finally stir in the egg-yolk and salt. Apply to the skins at a temperature not higher than 90 de-

grees Fahr. Two gallons of this fat-liquor is sufficient for one dozen skins. Care should always be taken to cool the soap and oil emulsion before adding the egg-yolk, as the latter will coagulate if the emulsion is of a higher temperature than 75 degrees Fahr.

Receipt No. 3.—This is a good fat-liquor for black skins and for skins dyed with alizarine dye:

Good Fat-Liquor Soap	8 ounces.
Olive Oil	2 pounds.
Treated Cod Oil	2 pounds.
Salts of Tartar.....	3 ounces.

Boil the soap in a few gallons of water until it is dissolved; add the oil and boil and stir for fifteen minutes; then add the salts of tartar dissolved in two quarts of water. Enough water should now be added to make twelve gallons of fat-liquor, this quantity being sufficient for one hundred pounds of skins. Use at 140 degrees Fahr.

Receipt No. 4.—This is an excellent fat-liquor for heavy skins, black or colored:

Conti Castile Soap	8 ounces.
Olive Oil	2 pounds.
Moellon Degras ...	2 pounds.
Salts of Tartar.....	3 ounces.

Any good fat-liquor soap can be used in place of the castile. The fat-liquor is prepared in the same manner as No. 2, the moellon degreas being added after the oil and soap have been boiled and stirred. These quantities of material are for twelve gallons of fat-liquor, which is sufficient for one hundred pounds of skins.

Receipt No. 5.—An excellent way to color and fat-liquor goatskins is to mordant them with vegetable tanning extract, then to fat-liquor them, using for one hundred pounds of skins:

Acid Fat-Liquor	4 pounds.
Water at 125 degrees Fahr.....	10 gallons.

Drum the skins in this fat-liquor thirty minutes, then color them with acid dye, wash them, strike them out, oil the grain, and dry out for finishing.

Acid fat-liquor may also be used after the skins have been colored. The exact quantity to use must be determined by the degree of softness that is wanted. From four to five pounds will generally be sufficient for one hundred pounds of leather. The drum should be heated up and the skins drummed in it until they are warm before applying the fat-liquor, so that the oil will not congeal. When the skins are taken out of the drum, rinse them in a tub of clean warm water to remove every trace of grease, strike them out, but do not oil the grain and then hang them up to dry. A very clear, bright finish can thus be obtained.

The drum that is used should be perfectly clean and free from all soap, tanning material and grease; the skins and the liquor must be warm, and the skins should be drummed in the liquor for thirty or forty minutes. The results will then be all that could be desired.

Receipt No. 6.—For dull finished goatskins this fat-liquor is recommended:

Palermo Fig or Other Soap	1 pound.
Neatsfoot or Olive Oil.....	2 pounds.
Moellon Degras.....	2 pounds.
Caustic Soda	1 ounce.

Boil the soap in a few gallons of water until it is dissolved; then add the oil and boil twenty minutes; turn off the steam and add the degreas to the mixture and stir very thoroughly for five minutes; finally add the caustic soda dissolved in two quarts of water and add sufficient water to make twelve gallons of fat-liquor. Apply to the skins at a temperature of 125 degrees Fahr., and run them in it for one-half hour; then let them drain for twelve hours before striking them out, oiling the grain and drying out for finishing.

Egg yolk may be used in place of moellon degreas in making the fat-liquor.

Oiling, Drying and Staking.—The next step is striking out the grain of each skin and then applying thereto a coat of glycerine and water, equal parts of each. This is put on with

a rag or a sponge and evenly over the grain. The skins are then placed grain to grain over a horse and left to draw for an hour or two. The next operation is to again strike out the leather, this time somewhat harder than before, and to apply to the grain a light coat of oil. The leather should be very thoroughly struck out, all wrinkles and marks of the tool removed and the grain laid down flat and smooth. The water should be well pressed out of the leather before the oil is applied.

Any one of the following oils may be used: Neatsfoot, olive, sperm or any good special leather oil; mixtures of neatsfoot or olive and paraffine oils are also good. For instance, equal parts of neatsfoot and paraffine make a good oil for either glazed or dull finish. One part olive oil and three parts paraffine is another good oil mixture to use. Specially treated oil is better than the ordinary grade as it is less apt to gum and spew, and generally glazes brighter. It is good practice to heat the oil, applying it hot to the skins and rubbing it in with a sponge. The oil must be applied evenly and lightly since too much of it interferes with the attempts to get a bright finish. After being oiled, the skins are hung up to dry. Drying is most satisfactorily effected in a moderately warm room provided with fans to keep the air in circulation. Colored skins should be dried in a dark room since strong light may cause the color to fade. When perfectly dry, they should be put into a cool, dry and clean room and left therein until it is necessary to finish them.

Thorough preparation for staking is a matter of importance in order that the skins may work out soft with the least amount of labor. Take a dozen of them at a time and put them into warm water in a clean tub and leave them in the same long enough to become wet, then place them in piles or in a clean box, cover the top of the pile with wet burlap or canvas or sawdust, and leave them until the next morning, when they will be found in good condition to be staked. Staking and drying should be continued until they are worked out, dry and soft.

Goatskins are generally staked both ways on staking machines. The necks and shanks are often staked by hand.

To remove roughness from the flesh, the skins are run on an emery wheel or on a fluffing machine. They are then seasoned and finished.

Clearing the Grain of Grease. Receipt No. 1.—Prepare a solution of lactic acid by adding one quart of the acid to eight quarts of water. This solution should be rubbed into the grain with a sponge, a light coat being applied and the skins dried. This treatment removes whatever grease there may be on the grain.

Receipt No. 2.—Dissolve one ounce of black nigrosine in one gallon of water, and to the solution add a small quantity of wood alcohol. Apply this to the skins, rubbing it in well; then dry and apply seasoning.

Seasonings for Glazed Finish.—A brilliant glazed finish can be obtained by using any of the seasonings prepared in accordance with the following formulas. The seasoning should be rubbed into the grain, a light and uniform coat being applied. The less seasoning used the better the finish. Two applications of seasoning are always necessary to get a good finish and frequently it is advisable to apply a third coat. After the first coat has been applied, the skins are dried and glazed; then the second coat is put on, and the skins again dried and glazed.

Receipt No. 1.—

Logwood Liquor.....	6 quarts.
Blood	2 quarts.
Orchil	$\frac{1}{2}$ pint.
Water	1 quart.
Ammonia	$\frac{1}{4}$ pint.
Milk	$\frac{1}{2}$ pint.

Receipt No. 2.—This receipt makes nine gallons of finish.

Beef Blood	14 pints.
Water	1 pint.
Milk	1 pint.
Glycerine	2 tablespoonfuls.
Orchil.....	$\frac{1}{2}$ pint.
Nigrosine solution	$1\frac{1}{2}$ pints.
Ammonia	1 pint.
Logwood Liquor.....	Sufficient.

The nigrosine solution is made by dissolving one-half pound nigrosine black in a gallon of hot water. When all the ingredients are mixed add enough strong logwood liquor, containing no alkali, to make nine gallons of finish.

Receipt No. 3.—

Logwood Liquor	6 gallons.
Bichromate of Potash	1 ounce.
Beef Blood	2 quarts.
Ammonia	2 quarts.
Glycerine	1 quart.
Vinegar Black	2 quarts.

Dissolve the bichromate of potash in a little hot water; add it to the logwood. Add a little carbolic acid to the blood; then stir it into the logwood liquor. Then add the glycerine, vinegar black, and lastly the ammonia. Stir the mixture while it is being made and then strain it through cloth.

Receipt No. 4.—

Blood Albumen	1 pound.
Nigrosine J.	5 ounces.
Logwood Crystals	1 ounce.
Wood Alcohol	1 gill.

Dissolve the blood albumen in two pounds of water over night. Put the nigrosine and logwood into three gallons of water and boil until dissolved; when the solution is cold add the dissolved albumen and wood alcohol. A little carbolic acid may be added to the finish.

The first glazing does not require such heavy pressure as the second and third glazings. Three light coats of seasoning and three glazings produce a more satisfactory finish than two heavy coats. The finishing requires skill and care in order that the luster will be clear and bright and the grain well set down. The Baker and Bower glazing machines are considered the best for glazing goatskins, some finishers preferring one, and others preferring the other.

After the glazing is completed, the leather receives a very light coat of finishing oil. Very little oil is put on, the finish being merely wiped over with an oily sponge. This oiling is the finishing touch, the leather being then ready for market.

Receipt No. 5.—Seasoning for colored leather:

Egg Albumen	1½ gallons.
Bichromate of Potash.....	¼ ounce.
Acetic Acid	10 ounces.
Water	5 gallons.

Dissolve the albumen in the water; add the other ingredients, mix thoroughly; then add a teaspoonful of sperm oil and two quarts of water. Use this for the first seasoning. After the skins have been glazed once apply the following:

Blood	3 gallons.
Vinette	2 pints.
Water.....	5 gallons.

Prepared seasonings can be obtained ready-made. Many leather manufacturers prefer to buy them, and others to prepare them themselves.

Dull Finish.—When dull finished leather is wanted, the skins are staked and trimmed, then given a coat of finish, hung up and dried, then given another coat of finish, dried again and then ironed with a hot iron. Heavy skins may finally be staked lightly; light ones staked or not according to their condition; generally the ironing completes the process. Heavy skins staked after ironing feel softer and fuller than when not staked. A good seasoning for dull finish is made of:

Ivory or other White Soap	1 pound.
Neatsfoot Oil.....	1 pint.
Whole Flaxseed	8 ounces.
Beeswax	3 ounces.
Nigrosine Black	3 ounces.
Powdered Aloes	1 ounce.
Wood Alcohol.....	½ pint.

Boil the soap, oil, flaxseed and beeswax in two gallons of water; when the solution is cool, strain it. Dissolve the nigrosine in a quart of water and add this solution to the first. Then dissolve the aloes in the wood alcohol and add it to the finish. Stir thoroughly for several minutes. This makes a fine dull finish with a nice dry feel. The grain for dull finish should be oiled with treated neatsfoot or dull morocco oil before the

skins are dried out. The oil helps the color and makes a soft grain.

PROCESSES FOR WHITE GOAT LEATHER.

Tanning with Sulphate of Alumina.—Goatskins for white leather are limed, bated and pickled in the usual manner, or in the same manner as skins for glazed kid. Pickling may be done in a paddle vat or in a drum. Pickling in a paddle has been described; pickling in a drum is done in the following manner: For each hundred pounds of skins use fifteen gallons of water, one pound of sulphuric acid and fifteen pounds of salt. Drum the skins in this liquor from thirty minutes to one hour, according to their thickness, then horse them up smoothly and let them drain for several hours.

Prepare the tanning liquor by boiling twelve pounds of German sulphate of alumina in ten gallons of water in a clean barrel or tub. In a clean pail dissolve by boiling in one gallon of water one and one-half pounds of bicarbonate of soda. Pour the soda solution very slowly and with constant stirring into the solution of sulphate of alumina. The mixing must be done very slowly or the liquor will be spoilt. When the liquor has become cold it is ready for use.

To tan the skins, put them into the drum with ten gallons of water, in which have been dissolved one pound of Glauber's salt and three pounds of common salt. These quantities of water and salt are for one hundred pounds of pickled skins.

Run the skins in this Glauber salt solution for fifteen minutes, then drain off the liquor. Dissolve four pounds of salt in ten gallons of water, 75 degrees Fahr., and put this solution into the drum with the skins and drum the skins in it for fifteen minutes. Then pour into the drum without stopping it, one-half of the alumina and soda solution and run the drum from two to three hours; then take the skins out and horse them over night. The next day hang them up to dry. When they are dry, put them back into the drum with eight gallons of water and run the drum ten minutes; then add the other half

of the alumina and soda solution and drum the skins from two to three hours. The tanning is now completed. Drain the skins for twenty-four hours, then hang them up to dry. When they are dry, store them away for two weeks before finishing them. The fat-liquor that is applied to the skins is sulphated oil or acid fat-liquor. For each one hundred pounds of dry skins take seven pounds of the oil and stir it into eight gallons of water, 95 degrees Fahr. Dampen the skins and let them lay until the next day, then fat liquor them. Put them into the drum, which should be as clean as possible, with the warm oil solution and run them in it for forty minutes; then place them over a horse until the next day.

The next day strike them out on the grain and apply a mixture of French chalk, two parts of glycerine and four parts of water. Give the grain a liberal coat of this dressing, and then hang the skins up to dry.

When they are dry, dip them in warm water and roll into a tight roll and leave them over night. Then stake them out and tack them smoothly on boards. If they do not appear to be fully tanned, they can be retanned; and if they are not as soft as desired they can be dampened and given another application of the fat-liquor.

Sulphonated oil can be bought almost as cheaply as it can be made in the tannery. Castor oil is the most suitable oil for sulphonating and produces the most satisfactory results when used as a fat-liquor.

Tanning with Alum, Flour and Salt.—When this process of tanning is used, it is best to remove the acid pickle from the skins by a drench of whiting and salt or one of sour bran and salt. One hundred pounds of drenched skins may be tanned with five pounds of alum, ten pounds of salt and twenty pounds of wheat flour. These materials are dissolved and made into a pastelike liquor with ten gallons of lukewarm water and applied to the skins in a drum. They are drummed in the same for from one to two hours or until they have absorbed the ingredients of the paste. They are then hung up and dried

and kept for some time before they are fat-liquored and finished. Fat-liquoring is done with sulphonated or Turkey-red oil, the skins being then dried again, staked and tacked. If colored skins are wanted they can be colored and then fat-liquored or they can be colored after they are fat-liquored, dried and staked.

MOCHA CASTOR GLOVE LEATHER.

The tanner who wants to make mocha castor glove leather from kid and goat skins will find the following described process satisfactory.

The dry skins require, first of all, very thorough soaking. Soak them in clear, cold water for twenty-four to thirty-six hours, then drain and cut them open. To further soften the skins and to make them perfectly clean for the lime, run them in a mill with plenty of water, then let them drain before fleshing and liming them.

Liming should be done in clean, white limes, using no red arsenic or sulphide of sodium. The first lime should be clean, white and weak, the skins being passed from it into stronger lime and limed very thoroughly; or a gathering lime can be used by hauling the skins out each day and adding fresh lime. When the hair comes off easily, the skins should be unhaired and the grain frizzed. After frizzing, put the skins in weak lime water for two or three days, then wash them in warm water and drench them.

Drenching is done with lactic acid, in a drum. One hundred skins, unhaired and washed, require about one quart of acid in ten pails of water at a temperature of 90 degrees Fahr. Mill the skins in this solution for one hour, then rinse them in warm water, let them drain and they are then in condition to be tanned.

The tanning is done with alum, salt, egg yolk and flour. For each dozen skins, dissolve twelve ounces of alum and four ounces of salt so as to make a pail of liquor and mill the skins in this solution for thirty minutes; then add one pail of flour

for each ten dozen skins and one quart of fresh egg yolks, and mill the skins thirty minutes longer. Take them out of the drum and hang them up to dry. When they are dry, put them away in a dry, cool place for a few weeks to give them time to become entirely tanned. To finish the skins, dampen them and mill them in flour, then knee-stake them, dry them and then run them on an emery set with fine emery. After this has been done, wash them with water, and give them two quarts of egg yolk to twelve dozen skins. Then dry them again, knee-stake them, and finish them on the finest emery.

The skins should now be very soft, dry and white, and can be used for white gloves or other purposes for which such goods are required. If colored skins are wanted, they can be easily colored any shade as they take the dye readily; then staked and finished with the finest flour emery. The finished leather, when the work has been properly done, is very soft and full and either a nice white or of a deep and uniform color. This process can also be used on skins with the grain on. Sulphonated oil may be used in place of egg yolk. It is dissolved in warm water and the skins milled in the solution. They acquire by this treatment great softness and strength and a finer appearance. These methods of tanning are excellent for any kind of kid glove leather.

SECTION SIX.

CHROME-TANNED SOLE LEATHER.

THIS leather is of comparatively recent introduction and being something of an experiment has not yet come into general use. It possesses several qualities that assure for it continued and increasing sale as time goes by. It is more waterproof than vegetable-tanned sole leather, and is more durable. It is confidently predicted by those who are in position to speak with knowledge of conditions and tendencies that chrome sole leather is the sole leather of the future.

The manufacture of this leather is not as difficult nor complicated as some tanners would have others believe. It is really more easily made than chrome upper, or vegetable-tanned sole leather. The most essential points to be observed are selection of proper hides at the beginning, and liming and bating them so as to leave them as plump as possible, and filling of the finished leather with waterproof filling.

Plump hides that weigh from forty to sixty-five pounds are the most suitable; those of large spread will not do. The manufacture of this leather calls for drums, paddle wheels and tacking frames, by means of which the various processes can be carried out most expeditiously. The tanner of chrome sole leather should be in position to place the hides not suitable for his purpose, as they can be made into some other kind of leather.

Soaking.—The hides are soaked in the same manner as for other heavy leather. Trimming is done in the hide cellar, and the hides are then soaked in clean cold water. It is advisable to hang them in the water as better results are obtained by this method than by throwing them into the water. The latter, if

hard, can be softened and its soaking and cleansing powers increased by adding a solution of five pounds of borax to one thousand gallons of it. After the hides have been hanging in the water twenty-four hours, they should be taken out and washed a few minutes, then put back into the same soak for another twenty-four hours. They may then be split into sides and fleshed and put back into clean cold water for twenty-four hours. Sometimes they are fleshed after the last twenty-four hours' soaking. After soaking and fleshing have been accomplished they are toggled together and started in the liming process.

Liming.—Liming is effected most satisfactorily by having a row of limes and reeling the hides from one lime into another for six days, which is usually sufficient. The first lime is prepared by using two pounds of lime for one hundred pounds of hides, slaking the lime and adding it to the water in the vat or pit. The hides remain in this lime twenty-four hours; they are then reeled into the second lime, which, like the first, contains two per cent. of lime to the weight of the hides. After the stock has been in this second lime twenty-four hours it is reeled into the third lime, which should contain one and one-half pounds of lime and one pound of sulphide of sodium to each one hundred pounds of it. At the end of twenty-four hours the hides are passed into the fourth lime which should be same as lime number 3. The fifth and sixth limes should each contain two pounds of lime to each one hundred pounds of hides, the latter remaining in each lime twenty-four hours. A little sulphide of sodium may be used in the last two limes, but the quantity should be small, and sometimes it may be omitted entirely, depending upon the condition of the stock. After the hides have been in the sixth lime twenty-four hours they should be reeled into water of about 80 degrees Fahr., and left in it three or four hours, when they will be found to be in condition for unhairing on a machine. After unhairing, they are put back into clean warm water and then worked thoroughly over the beam, washed in cold water when they are

ready to be bated with lactic acid. Very heavy hides may require one day longer in the lime; it may be necessary to refresh after unhairing. These and other minor points must be decided by the judgment of the tanner.

Reeling from one lime into another should be done carefully, and each hide should be spread out as much as possible, which insures more uniform results than when they are thrown in carelessly or in bunches. Liming can also be done by suspending the hides in the lime liquor, by the use of paddle wheels and also by first removing the hair by means of sulphide of sodium, and then liming two or three days. Careful working out of the grain insures clean, elastic grain that will not readily crack.

The limes should be cleaned out every four weeks, starting with the first one and cleaning the series in rotation.

Bating.—The removal of the lime from the hides is accomplished most effectively and with the least danger and unpleasantness by the use of lactic acid and warm water, the process being performed in a paddle vat. The required amount of water is run into the vat and heated to 85 degrees Fahr., and three pounds of lactic acid to each one hundred pounds of hides, hair weight, are added; the bath is then plunged or stirred and the hides are put into it. They may be stirred about in the bate for one or two hours, left in over night and then run one hour in the morning, or they can be paddled four or five hours, then taken out and washed for ten minutes. The lactic acid bate should be made fresh for every pack of hides. The temperature should not exceed 85 degrees Fahr., and a cold bate can be used, containing salt as well as lactic acid. After the hides have been bated and washed in cold water they are ready to be pickled and tanned. This method of treatment removes the lime from them without depleting them too much.

Pickling.—There are two methods of pickling and tanning hides for sole leather. One consists of pickling with sulphate of alumina and salt and tanning in vats, and the other of

pickling with sulphuric acid and salt and tanning in pits or rocker vats. In each case one-bath chrome liquor is used, it being the most satisfactory way to tan heavy chrome leather.

When pickling is effected with sulphate of alumina and salt, five or six pounds of the former and eighteen pounds of the latter dissolved in fifteen gallons of water are used for each one hundred pounds of hides in the pack. The liquor should be cold when used, and the hides be run in it in a drum from two to three hours. One-half of the solution should be put into the drum, and after the hides have been drummed in it one hour, the other half should be put into the drum and drumming continued from one to two hours longer. The hides can then be drained twenty-four hours and either hung up and dried, dampened and tanned, or put at once into the tanning liquor. The better process is to hang them up to dry after draining at least twelve hours, since this method makes firmer and more solid leather. When dry they are dampened and made soft and pliable in a tub of warm water, then drummed in cold water for fifteen minutes, which puts them into condition to be tanned.

The process of pickling with sulphuric acid and salt is as follows: For each one hundred gallons of water in a paddle vat fifty pounds of salt are used. The washed hides are weighed, and for every one hundred pounds of them one and one-half pounds of sulphuric acid and six pounds of salt are added to the salt water in the vat. The liquor is thoroughly plunged and the hides put in. The paddle is run one hour, then allowed to rest two hours; next again run one hour and the hides are left in over night. The next morning they are placed smoothly over horses and allowed to drain twenty-four hours, when they are put into the tan liquor.

Tanning.—Hides pickled with sulphate of alumina, and dried and softened with warm water are tanned by suspension in chrome tanning liquor; those pickled with acid and salt may also be tanned by the suspension method or by the use of rocker vats. The liquor for acid pickled hides should contain considerable salt to hold the acid in check.

A practical method of tanning hides pickled with alumina and salt is carried out as follows: For each one hundred gallons of water in the vat five pounds of concentrated chrome liquor are dissolved and added. Then for each one hundred pounds of hides from fourteen to sixteen pounds of chrome material are dissolved in six gallons of hot water. This solution is divided into four portions. One portion is added to the liquor in the vat; the hides are tacked on sticks with brass nails and suspended in the prepared tanning bath. They must not be hung too closely together, and should be entirely covered by the liquor. After they have been in the liquor twenty-four hours they are taken out and allowed to drain off, the liquor running back into the vat. The second portion of tanning material is then added to the liquor, plunged, and the hides are put back, their positions being changed from what they were during the previous immersion. At the end of the second twenty-four hours, they are hauled out and drained as before and, after adding the third portion of chrome liquor to the liquor in the vat, they are put back and left in another twenty-four hours. They are then raised out of the tan and, after adding the fourth portion of tanning material, are put back and left in the liquor two days. After draining a few hours they are again put into the liquor and kept therein two or three days, at the end of which time they should be tanned through. To test the tan-nage a piece of the thickest part of a butt may be put into boiling water for a few minutes. If it draws up and becomes hard, the leather is not fully tanned and should be put back into strengthened liquor until it is tanned. If the piece does not draw up but remains flat the leather is tanned. Ordinarily no retanning or further tanning is required as the leather will be found to be well tanned, full and plump. The leather should lay in smooth piles for several days. It should then be washed in warm borax water, three pounds of borax and fifteen gallons of warm water being used for one hundred pounds of it. In this water the hides are washed forty minutes, then one hour with running water, next drained and pressed for fat-liquoring and finishing.

The tanning liquor for acid pickled stock may be the same as for alumina pickled hides, but it should contain forty pounds of salt for each one hundred gallons of liquor. Tanning in rockers for harness, belt and strap leather will later on be fully described, and the same method and procedure may be followed in tanning sole leather.

After the leather has been washed and pressed it is given a light fat-liquor of two pounds of soap and one pound of neats-foot or cod oil in twelve gallons of water at 150 degrees Fahr., for one hundred pounds, and drummed in this fat-liquor three-fourths of an hour, then set out hard and tacked on frames to dry. When perfectly dry it is filled with the waterproof filling, this being very important in finishing it and making it waterproof and durable. Tanners can buy the filling accompanied by full directions for its use. Chrome sole leather is also given weight and filling after it is tanned by being drummed in quebracho extract. It is claimed that seven to eight pounds of quebracho liquor, 70° barkometer, for each side of leather should be drummed into the latter after the chrome tanning is completed. Leather treated in this manner resembles vegetable tanned sole leather in appearance, repels moisture, wears well and can be sold by the pound the same as the older tannage. This combination process takes about thirty days from the raw hide to the finished product.

CHROME-TANNED HARNESS LEATHER.

In the handling of hides for chrome harness leather the methods of depilating and bating must be such as not to deplete them, and to preserve the strength of the fibers. In order to get heavy leather heavy hides must be used, weighing from sixty to eighty pounds, and they must be plump, since there is no way of plumping chrome leather. The hides are trimmed and hung in cold water to soak. After soaking twenty-four hours they are split into sides, put back into the water and soaked twenty-four hours longer; they are then fleshed and soaked over night in fresh water. Splitting into sides and flesh-

ing can also be done after the hides have soaked forty-eight hours, they being then resoaked over night to be made as soft and clean as possible before being limed.

Liming.—The sides are next toggled together in a long chain and put into the first lime. For one hundred pounds of them two pounds of lime in sufficient water constitute the first lime; in this they remain twenty-four hours when they are reeled into the second lime.

The latter should contain two pounds of lime and one and one-half pounds of sulphide of sodium for one hundred pounds of hides. The lime should be slaked with hot water and the sulphide of sodium, dissolved separately, mixed with it. The lime and sulphide mixture is put into the required amount of water in vat No. 2 and the sides are then reeled into the liquor and left therein twenty-four hours. The third lime should, like the second, contain two pounds of lime and one and one-half pounds of sulphide of sodium for one hundred pounds of hides. The latter are reeled from the second into the third lime and left in the same twenty-four hours.

The fourth lime should contain two per cent. of the weight of the hides of lime, the same as the first lime, the hides remaining in it twenty-four hours, when they are passed into clean warm water of 90 degrees Fahr., from which, after three or four hours, they are unhaired on the unhairing machine. After the hair has been removed they should be washed with running water for fifteen minutes, then put into clean warm water for two hours, after which they are fine-haired and worked on the grain. Thorough working out of the grain is necessary to insure clean, tough grain that will not crack.

Bating.—This may be done with chicken manure, lactic acid, Dermiforma or Puerine. Chicken manure should be soaked in warm water for thirty-six hours before it is used. Two bushels of dry material are stirred into twenty-five gallons of water, heated to 130 degrees Fahr. One hundred and fifty sides require two bushels of the soaked manure, added to warm water in the vat in which the bating is to be done. The hides

are processed in the bate-liquor for one hour, then allowed to rest two hours, next run half an hour, and then left in the liquor one hour. They should now be fully bated, but if they are not, the liquor may be warmed up and bating continued a while longer. When bated they should be washed off and put into a cold lactic acid bath over night, using one pound of acid to each hundred pounds of hides. In the morning they are in condition to be pickled.

Bating with lactic acid is done in the following manner: For every one hundred pounds of hides from one to two pounds of lactic acid are used in water at 90 degrees Fahr. The paddle is run one hour and the hides are then left in the liquor over night. The next morning the paddle is again run for one-half hour; the hides are then washed with clean water and put into the pickling liquor. The manure or other bacterial bate produces finer grained leather than the lactic acid process.

Pickling.—This process is carried out in a paddle vat. To each hundred gallons of water in the vat thirty pounds of common salt are added, and to this liquor, for each hundred pounds of hides, one and one-half pounds of sulphuric acid and fifteen pounds of salt. For succeeding packs fifteen pounds of salt and one and one-half pounds of acid are taken, thirty pounds of salt being only used for the first pack.

The paddle should be run for one hour, then allowed to rest two hours, then run one-half hour, and the hides left in the liquor over night. The next morning they are removed and placed in piles for twenty-four hours; they are then put into the tan liquor.

Tanning.—A good way to tan the hides so as to get full flanks and bellies and a fine smooth grain is by the use of rocker vats. For every hundred gallons of water in the vat thirty-five pounds of salt are used, and after plunging the water, one gallon of concentrated chrome liquor is added. The hides are hung in the liquor and rocked six hours; another gallon of tan liquor is now added and they are rocked two hours and then left until the next day. One gallon more of the tan

liquor is then added and the rocker is run six hours; another gallon of tan liquor is then added, the hides are rocked one hour and then left at rest until the next day, when another gallon of chrome material is added to the liquor, making five gallons in all. The hides are then rocked four or five hours. Four ounces of borax are then dissolved for each hundred pounds of hides and the solution is added to the tan liquor, the rocker being run one hour and then allowed to rest until the next morning. On the fourth, fifth, sixth and seventh days the hides are rocked two hours in the morning and two hours in the afternoon. The test for tannage is to boil a piece of thickest hide. If it remains soft the hides are tanned; if it curls up and becomes stiff they are not fully tanned and must be left in longer and the liquor must be strengthened.

When the leather is tanned it is piled down in smooth piles for forty-eight hours. It is next washed for half an hour in a bath composed of one pound of borax in fifteen gallons of water for each hundred pounds of leather, and then for one hour in cold running water.

Another practical mode of tanning consists of pickling the hides with sulphate of alumina and salt, then drying them, dampening and softening with warm water, and finally tanning by suspending them in chrome liquor. This process is fully described in the section on chrome sole leather. It produces plump, well tanned leather.

Retanning.—After the leather is fully tanned and washed it is retanned with quebracho extract or with gambier, preferably with the former. For each average side from one to two pounds of solid quebracho extract are used. The extract is dissolved in boiling water; enough water is then added to make fifteen gallons of liquor for each hundred pounds of leather. The sides are run in the liquor one hour, then placed in piles until the next day, when they are either pressed or put through a wringer. If pressed, they should be run in a dry mill for fifteen minutes to remove the press marks. The leather is then shaved just enough to remove the flesh and

make the backs smooth and clean. When gambier is used, about four pounds of it are required for one hundred pounds of leather; otherwise the process is the same as with quebracho.

Blacking and Stuffing.—The leather, retanned and shaved, is now in condition to be blacked and stuffed. There are two courses that may be pursued. The leather may be blacked and then stuffed or it may be first stuffed, then dried, buffed and blacked. Both methods will here be described.

When the leather is blacked first and then stuffed, it is taken, a side at a time, slicked out smooth on a table and given a coat of logwood liquor, then a coat of striker, next another coat of logwood and more striker, after which it is washed, run through a wringer, and put into condition for stuffing.

The logwood liquor is made of six pounds of logwood crystals and two pounds of borax in fifty gallons of water. The striker is made of seven pounds of copperas and five pounds of blue vitriol in fifty gallons of water, although any other good striker may be used. The leather, after it has been wrung, is ready to be stuffed. One hundred pounds of it requires ten pounds of hard wax, ten pounds of best stearine and five pounds of good hard grease. The materials should be boiled and thoroughly mixed and applied to the leather in a hot drum. The leather is drummed forty minutes, then placed in piles, covered up and left until the next day. It is then struck out on the flesh side, hung up until partly dry, and next stoned out on the grain. The grain is then given a light coat of cod oil and again gone over with the stone and slicker. The leather is then hung up to dry. If it is to be stuffed after shaving and blacked later, it should be hung up and dried until about three-fourths dry before it is stuffed. The bellies and flanks should have more moisture in them than the rest of the side.

The stuffing described above may be used, or a mixture of stearine, tallow and wax. The latter is made of sixty per cent. stearine, twenty per cent. tallow and twenty per cent. hard wax, heated to 190 degrees Fahr. Of this mixture twenty-four pounds are used for one hundred pounds of leather. The

leather is weighed and run a few minutes in the hot drum. The stuffing is then thrown in and the drum run forty-five minutes. After lying in a covered pile over night the leather is struck out on flesh and grain, and hung up to dry. When it is partly dry, the grain is reset, when it is again hung up and thoroughly dried. When dry, the scratches and imperfections can be buffed from the grain, and it is then ready to be blacked with logwood and striker. A sig to prepare the leather for the logwood is necessary. After the leather has been blacked it is washed off, slicked and hung up to dry.

Finishing is done with mutton tallow and cod oil. Three pounds of the former and two pounds of the latter are melted together, and the grain is given a good coat of the mixture, which is thoroughly glassed in, the leather being then left in a pile for twenty-four hours. It is then reglassed, which is the finishing touch.

In case a dry feeling leather is wanted the sides are seasoned with a solution of blood albumin, isinglass and nigrosine in logwood liquor, then dried and oiled off with hot paraffine oil or with a mixture of paraffine and neatsfoot oils. Sometimes a coat of starch decoction is applied to the flesh side.

By using seven pounds of quebracho liquor, 70 degrees barkometer, for each side, weight and solidity are given the leather. Chrome-tanned harness leather made by the methods that have been described has far greater tensile strength and is more waterproof than the ordinary bark-tanned product.

CHROME-TANNED BELT AND STRAP LEATHERS.

Hides for these two classes of leather are treated in the beamhouse in the same manner as those for chrome harness and sole leathers. For belting leather, however, they are trimmed into butts after liming or after bating. The butts should be about four and a half feet long and four feet wide, though some will be four and a half feet wide. The bellies and heads are tanned with extract and sold for offal. The butts are then tanned with one-bath chrome tanning material in a drum or in

a vat. Tanning in a drum is effected by pickling the butts and tanning them according to the procedure outlined for chrome upper leather. When a vat is used the process is the same as for harness and sole leathers.

After the butts have been tanned and washed they are fat-liquored with a fat-liquor of soap, oil and degreas. One hundred pounds of leather require one pound of soap, five pounds of degreas and two pounds of neatsfoot oil boiled an hour in water to which six ounces of borax have been added. There should be twelve gallons of fat-liquor. The butts are first run in a drum for fifteen minutes with twelve gallons of water at 160 degrees Fahr., and four ounces of salts of tartar for each hundred pounds of leather. The water is then drained off and after the fat-liquor, warmed to 140 degrees Fahr., has been put in, the leather is run in it forty-five minutes. It is then placed in piles for twenty-four hours when it is taken and set out good and hard. The grain is oiled with cod oil or with a mixture of cod and paraffine oils; the butts are then hung up to dry. The next operation is stretching, the object being to get all the stretch out of the leather. The butts are soaked in hot water and piled down over night. The next day they are stretched in belt stretchers as tightly as possible and allowed to get thoroughly dry, when they are finished and ready for cutting up into belts.

Good leather is also made by fat-liquoring the butts with a soap solution, drying and dampening them and then stuffing them with German degreas, paraffin and paraffin oil. Drying and stretching are effected in the manner as above described. A satisfactory stuffing mixture is made of four pounds of cod oil, two pounds of black degreas and six pounds of stearine for one hundred pounds of leather. No soap is used with this stuffing which is applied at a temperature of 165 degrees Fahr.; the butts are then dried and finished.

The trimmings taken from chrome belts may be retanned with hemlock or oak liquor and sold as trimmings from oak belts. They are first drummed in hot salt solution, next given a light

retan with hemlock extract and then laid away in strong hemlock or oak liquor, preferably the latter, until they are colored through, when they are dried and sold.

STRAP LEATHER.

There are numerous uses for which soft strap leather is suitable. The beamhouse treatment and the tanning are the same as for chrome harness leather. After the leather is tanned it is washed, shaved and fat-liquored with four pounds of moellon degreas, two pounds of cod oil, two pounds of wool grease, one pound of soap and eight ounces of alkali boiled and made into an emulsion with twelve gallons of water, this quantity being enough for one hundred pounds of leather.

After the leather has been drummed in this fat-liquor forty minutes, the latter is drained off, and the leather is washed in warm water containing one pint of ammonia to ten gallons of water. This water is drained off at the end of ten minutes, and the leather is then retanned with gambier, four pounds of it dissolved in fifteen gallons of water being used for one hundred pounds of stock. The leather is drummed in this liquor one hour; it is then set out on the grain and hung up to dry. Any rough spots can be buffed off before it is finished.

The finish is made by boiling eight ounces of Irish moss, eight ounces of starch, eight ounces of soap and one pint of olive oil in four gallons of water for thirty minutes; when cool the solution is strained and enough water is added to make eight gallons of finish. The leather is given a coat of this finish, staked on the flesh side, rolled and hung up to dry or tacked in frames. It should be rolled immediately after staking and before it has dried. When it is dry it is given a second coat of finish, dried and rolled again. This process makes very tough, pliable and durable leather that will outwear the best bark-tanned product made.



SORTING UPPER LEATHER.

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SECTION SEVEN.

THE MANUFACTURE OF GENUINE KANGAROO LEATHER.

KANGAROO skins are characterized by great suppleness, toughness, and a grain several times thicker than the grain of any other kind of skin. The grain, after tanning, is very compact and resists the penetration of water and moisture; and it does not peel off or crack as that of goat skins does. On account of these qualities kangaroo leather is splendid shoe material, standing in a class by itself, and is especially suitable for shoes for tender feet. Kangaroo skins come from Australia and are received by the tanner in dried condition. Excellent leather is made by tanning the skins in a chrome process; also by tanning with quebracho, gambier, palmetto, and by the combination process. The finishes are glazed and dull, the former for vamps of shoes and the latter for tops of patent leather shoes. Several practical methods of tanning kangaroo and wallaby skins will be described in this section.

Soaking and Softening.—The skins, having been dried as soon as they were taken from the animals, are hard and dry and resist the penetration of water to an unusual degree. Clear water softens them very slowly, and it is therefore necessary to use some chemical that will soften them more quickly than water alone will do it. Tanner's soda, borax or sulphide of sodium prove satisfactory for the purpose. By tanner's soda is meant what is known as Wyandotte soda. Forty or fifty pounds of this material dissolved in hot water in a barrel and poured into the soak vat softens the water so that it readily penetrates the skins, the quantity stated being enough for twelve hundred gallons of water.

Borax thoroughly softens the water and helps in giving the

skins a soft and silky grain. Five or six pounds of it are enough for one thousand gallons of water. Dissolve it in hot water, pour the solution into the soak and stir vigorously; then put in the skins.

When sulphide of sodium is used in the soak from one to two pounds, more or less, may be dissolved and added to every hundred gallons of water. Water containing sulphide of sodium readily softens the hardest skins and brings them back to the natural soft condition and freshens up the dried and withered grain.

The skins may also be softened in a strong lime or solution of salt and water; this quickly penetrates them and opens them out. The salt should be removed by washing before liming. Soaking can be hastened by drumming the skins when sufficiently soft in a drum, then putting them back into the water. But when sulphide of sodium or other material is used in the soaks it is not necessary to drum them unless they soften slowly; in that case running them in a drum assists materially in making them soft. Clean water is undoubtedly the best for soaking. Water in which previous lots of skins have been soaked softens them quite rapidly but its use has unpleasant features that make it less satisfactory than clean water. When the skins are sufficiently soft, they are drained and fleshed, and all flesh and fat removed before they are limed. There are several processes that can be used in liming and depilating, a few of which will here be described. Leather that is soft and supple, with a clear, fine and silky grain can be made only when the skins are properly limed and bated. More depends upon how these processes are done than upon any subsequent treatment. Skins that are properly prepared for tanning, tan and finish into fine, soft and durable leather.

Liming.—A good liming process for kangaroo skins is carried out in the following manner: To start with, the skins are put into a weak lime made up of sufficient water for the pack of them and two per cent. of lime, that is two pounds for every hundred pounds of soaked skins. After being in this liquor

one day, they are hauled out, and put back after plunging the liquor. On the third day two per cent. more of lime, well slaked, should be given; on the fourth day the skins are hauled out, and then put back after plunging the liquor. To strengthen the lime on the fifth day three per cent. of lime and one and a half per cent. of red arsenic, slaked and dissolved together, should be added; and on the sixth day the skins are hauled out and put back so that those that were on top before are now at the bottom, and those previously at the bottom are on top. On the seventh day three per cent. of lime and one and a half per cent. of red arsenic are added; on the eighth day it is advisable to haul the skins out and to warm the liquor to 80 degrees Fahr., then to put them back and after leaving them one day longer, to unhair them. If they are thoroughly softened and fleshed clean before they are put into the lime, the hair will come off easily; they are then washed ten minutes in a wash wheel in cold water, refreshed and worked for fine hair. The exact quantity of lime to use and the number of days to leave them in the lime depend upon their thickness. Thin, light wallaby skins can, of course, be limed in less time than heavy ones. The liming process described is for medium heavy skins. After fine-hairing, they are ready for bating.

A good liming process in which sulphide of sodium is used, that produces first-class results and that does not require fine-hairing is as follows: For one hundred pounds of skins three per cent. of lime and one and a half per cent. of sulphide of sodium are used as a first lime. In this the skins remain one day; they are then hauled out and the same quantities of lime and sodium added. On the third day, the skins are hauled out, and put back after plunging the lime; on the fourth day, the liquor is warmed to 80 degrees Fahr., the skins put back and left until the fifth day, when they are unhaired, washed, and bated.

A new lot of skins is started in the old lime, left in one day and then put into a new lime, using six per cent. of lime and three per cent. of sulphide of sodium, and on the third and

fourth days they are handled the same as the first lot, thus starting in an old lime and finishing out of new and fresh lime. Good skins are made by this process.

The skins can also be treated with sulphide of sodium in a drum and then limed a few days. In this process the hair is destroyed, but very tough and fine-grained leather results. For ten dozen skins twelve pounds of sulphide of sodium is dissolved in hot water in a tub or barrel. The skins and ten pailfuls of cold water are put into a drum, the solution of sulphide of sodium is then added, the drum is closed and the skins are drummed in the liquor for two hours and then left in the same over night. The next morning they are taken out of the drum, washed in cold water and then put into clean weak lime liquor for a few days. A liming should always follow the sulphide treatment or the skins will not be quite so fine textured when they are finished. Washing, refreshing and bating then follow as usual and they are then pickled and tanned.

Bating and Drenching.—A bacterial bate, such as Puerine and manure, give results in leather-making that other bating materials do not. It is the bacterial action of these bates which produces that softness and elasticity of grain, silkiness of texture and fine feel that are so much desired in the finished leather. Puerine is a substitute for manures in bating. It is a powder that is efficient and rapid in action, uniform in strength and cleanly to handle. Directions for using this article are furnished by the manufacturers, so they need not be given here. Bating should be done in a paddle vat which has a steam pipe with a box around it, so that the bate can be warmed while the skins are in it. To make a manure bate, one or two bushels of the material should be added to warm water in a barrel, stirred and mashed, and allowed to stand a few days or a week. When it is to be used, the material should be strained and poured into the paddle vat holding the volume of water required; the temperature of the bate is then raised to 95 degrees Fahr., the skins are thrown in, and the paddles set in motion. When the skins are soft and thin, they are taken out

of the bate, washed in warm water and are then ready to be pickled or tanned according to the method of tanning that is followed. If it is more convenient to bate during the night, warm the bating liquor to 95 degrees Fahr., put the goods into it and run the paddles one hour before stopping for the night. The skins should be thrown in as quickly as possible and the paddles kept running while this is being done. In the morning run the paddles one hour after warming the liquor to 85 degrees Fahr., then take the skins out and wash them in warm water to further cleanse and neutralize them.

Bating with Lactic Acid.—An excellent process of bating with a fermented bate is used in this manner: Prepare a paddle wheel with water at a temperature of 120 degrees Fahr., and put into it two pailfuls of dry bran and allow it to stand over night. The next morning bring the temperature up to 95 degrees Fahr., and take one pound of lactic acid for every hundred pounds of skins and put a part of it into the bran liquor, then throw in the skins and add the rest of the acid slowly afterwards. Run the paddle wheel for three hours more or less, then take the skins out and wash them. For the second pack run the bate liquor down about twelve inches, make up the loss with fresh water, and bring up the temperature to 95 degrees Fahr.; do not use any more bran but take one pint of lactic acid for every hundred pounds of skins and proceed as directed for the first pack. Continue in this way for six days, then run off all the bate liquor and make up a fresh liquor with water at 120 degrees Fahr., and two pailfuls of dry bran, allowing the same to stand twelve hours, and then proceeding in the manner described. Skins treated with this bate come out of the liquor soft and clean and in good condition (after washing) to be pickled or tanned.

Bating with Bran.—Some tanners prefer a bran drench to any other process of bating. A half barrel of bran is mixed with sufficient water to make a mush; this is covered up and allowed to stand forty-eight hours to sour. Into a paddle vat holding sufficient water to cover the skins, the sour bran is

emptied, and three pints of sulphuric acid and three pecks of common salt are added to the liquor, the latter is thoroughly stirred and warmed with steam to 90 degrees Fahr, From four hundred to four hundred and fifty kangaroo skins can be put into the bate and stirred about for four or five hours when they will be soft and clean. After this process is completed, they will be found to be free from undesirable matter and after a slight washing will be ready for the next process. Of these three bating processes that have been described, the tanner can take his choice and can rest assured that his skins will be bated in the best possible manner and will be put into just the right condition to be tanned.

Pickling.—For nearly all processes of tanning it is advantageous to pickle the skins. Pickling makes the leather more uniform and more easily tanned. To start a new pickling liquor add forty pounds of salt for every hundred gallons of water in a paddle vat, and stir until dissolved. Then for every hundred pounds of skins to be pickled add to the salt water ten pounds of salt and one and a half pounds of sulphuric acid. Plunge the liquor thoroughly and put the skins in. Run the paddle two hours, then place the skins over horses for twelve hours to drain before tanning them.

CHROME-TANNED KANGAROO LEATHER.

Two-Bath Process.—Weigh the pickled skins and for every hundred pounds of them dissolve five pounds of salt in twelve gallons of water. To this solution add five pounds of bichromate of potash dissolved in three gallons of water and four pounds of muriatic acid, put this liquor and the skins into the drum and run the drum three hours more or less. At the end of this length of time the skins should be a deep yellow all through; they should then be horsed up for twenty-four hours.

The second bath consists of twelve gallons of water, eighteen pounds of hyposulphite of soda and six pounds of muriatic acid for each hundred pounds of stock. The soda is dissolved and mixed into the water; the solution is put into the drum

together with the skins, and the drum started. The acid should be mixed into two gallons of water; as soon as the drum starts run the acid solution into it through a lead funnel attached to the gudgeon and run the drum from three to four hours or until the skins are blue through the thickest part of them and are fully tanned. Then take them out of the drum and place them smoothly over horses to drain for twenty-four hours; next wash them in borax water, and then in clear water, until all acid and salt are removed and they are perfectly neutral to the taste. The next process is coloring which follows the mechanical operations of striking-out, or pressing and shaving.

One-Bath Process.—1. For each hundred pounds of skins prepare a solution of one pound of Glauber's salt in eight gallons of water at 85 degrees Fahr. Throw this solution into the drum with the pickled skins and drum them for fifteen minutes. They should then be thrown up on each side of the drum, the plug pulled out and the Glauber's salt solution drained off; now replace the plug and throw into the drum ten pounds of common salt and eight gallons of water for each hundred pounds of skins and run the drum five minutes. Concentrated chrome liquor is then poured into the drum, a gallon at a time, at intervals of thirty minutes, until three gallons for each hundred pounds of skins have been poured in, when the drum should be run three hours or longer. Now dissolve in as little water as possible three fourths of a pound of bicarbonate of soda for each hundred pounds of skins and pour the solution into the drum and run the latter forty minutes longer. The tanning should now be completed, but it is advisable to add water to the liquor in the drum and to let the skins remain in it over night, then to set them to press and drain for twenty-four hours. After this they are washed for twenty minutes in warm water containing two pounds of borax for each hundred pounds of them, and then in clean water for fifteen minutes. The leather is then ready to be struck out or pressed, shaved, colored, fat-liquored, oiled and dried for finishing.

2. There are some other processes of one-bath tanning, the

following being a good one. The skins are weighed and put into the drum together with ten pounds of salt and twelve gallons of water for every hundred pounds of them and drummed in the brine for ten minutes. The chrome material is dissolved in warm water until the solution has a strength of 23 degrees Baumé. At the expiration of ten minutes one gallon for each hundred pounds of skins is poured into the drum; at the end of a half hour another gallon is poured in and the drum is run another half hour, then two gallons of chrome solution are added and the drumming continued two or three hours. Let the skins remain in the liquor over night, then wash as directed for the preceding process.

3. This process of tanning requires a preliminary drumming in a solution of sulphate of alumina and sal soda. For each hundred pounds of skins dissolve by boiling in five gallons of water three pounds of sulphate of alumina; and in another vessel dissolve by boiling in five gallons of water three pounds of sal soda. Pour the soda solution slowly and with constant stirring into the alumina solution; set the mixture aside until it has cooled down to 85 degrees Fahr. Put the skins into the drum together with six pounds of salt and six gallons of water and drum them for five minutes; then pour into the drum the solution of alumina and soda, and drum thirty minutes. Chrome liquor is then added to the liquor in the drum, a gallon at a time, until four gallons have been used for every hundred pounds of skins. Continue drumming until the skins are tanned through; then add bicarbonate of soda and let them lie in the liquor over night as directed for the first one-bath process; then wash the leather, strike it out or press it, shave it, and it is then ready to be colored.

4. Excellent leather is made by removing the acid pickle in a drench of sour bran and salt, then drumming the skins in a solution of sulphate of alumina and salt, following this with the chrome liquor, then washing and finishing them. After the pickle has been removed, put the skins into the drum together with three pounds of sulphate of alumina and six pounds of salt

dissolved in ten gallons of water for each hundred pounds of them, and drum them in this liquor thirty minutes, when they are ready for the chrome liquor. Three or four gallons of this are used per hundred weight of skins and the latter are drummed until tanned, left in the liquor over night, drained for twenty-four hours, washed, shaved, colored and treated in the remaining operations in the usual way. The author has tanned kangaroo skins by this process with very good results as regards plumpness, fineness of grain and toughness. They were limed in arsenic limes and bated with manure, then pickled and the pickle removed before tanning. Pickling can be omitted, however, for this process and the labor and expense of pickling and depickling can then be saved. Chrome-tanned skins, after shaving, can be retanned with gambier or palmetto, and then colored and finished the same as pure chrome leather. Very light skins can be made a little thicker and heavier by being drummed in quebracho liquor after they have been shaved.

METHODS OF DYEING KANGAROO SKINS.

Dyeing the Skins Black.—Receipt No. 1.—In this process logwood and bichromate of potash are used. For each hundred pounds of skins, dissolve by boiling in ten gallons of water:

Logwood Crystals.....	1½ pounds.
Fustic Paste.....	4 ounces.
Salts of Tartar.....	3 ounces.

Add five gallons of cold water to the liquor and use it at 125 degrees Fahr. Drum the skins in it for twenty minutes. While the drum is running, dissolve in a pailful of hot water:

Bichromate of Potash.....	1 ounce.
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Pour this solution into the drum and run the drum ten minutes. Then drain the liquor out of the drum and wash the skins in three changes of water. They are then ready to be fat-liquored. Borax can be used in place of salts of tartar to make the logwood liquor slightly alkaline, which is desirable. The washing after coloring is important to remove the dye

liquor so that the fat-liquor will go in. Coloring in this way can also be done after fat-liquoring if desirable.

Receipt No. 2.—A good color can be obtained with logwood and titanium salts in the following manner: For every hundred pounds of skins, boil until dissolved in ten gallons of water:

Logwood Crystals.....	1½ pounds.
Fustic Paste.....	4 ounces.
Borax	3 ounces.

In another tub dissolve in ten gallons of hot water for every hundred pounds of skins:

Titanium-Potassium Oxalate	5 ounces.
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Put the skins and half of the titanium solution into the drum and run the drum ten or fifteen minutes; then pour the logwood liquor in and run the drum fifteen minutes; finally to develop the color, pour in the rest of the titanium solution and run the drum ten minutes longer. Wash the skins and finish them, but have one pound of titanium salt in the barrel of seasoning and no copperas. The logwood liquor should be increased to fifteen gallons by the addition of five gallons of cold water and used at a temperature of 125 degrees Fahr.

Receipt No. 3.—In this process logwood, copperas and bluestone are used. Use the same quantities of logwood, fustic and alkali as given in the preceding receipts. Put the skins and five gallons of water into the drum, pour in the logwood liquor and start the drum. While the skins are running in the logwood, dissolve by boiling in four gallons of water, for each hundred pounds of skins:

Copperas.....	2 ounces.
Bluestone	½ ounce.

At the expiration of thirty minutes, pour this solution into the drum and continue drumming for fifteen minutes. Then drain the liquor out of the drum and wash the skins in two or three changes of water; then press and fat-liquor them.

Receipt No. 4.—Prepare logwood liquor as directed in Nos. 1 and 2; and drum the skins in it twenty minutes; then pour into the drum a solution of blue nigrosine made by dissolving in hot water:

Blue Nigrosine..... 3 ounces.

and run the drum for ten minutes. Then add copperas and bluestone or titanium solution as directed in Nos. 3 and 4. Drum the skins fifteen minutes, wash and fat-liquor. Fustic with logwood intensifies the black. Any one of these processes can be used with the assurance that the leather will have a good color.

FAT-LIQUOR FORMULAS.

After the skins have been colored and washed, they should be either pressed or struck out to get rid of the surplus water so that they can be fat-liquored. The fat-liquor drum, empty and clean, is heated with live steam, the condensed steam or water drained out, and the skins are then thrown in and drummed a few minutes to warm them; then the hot fat-liquor is poured into the drum and the skins drummed in it for forty minutes. All the oil and soap should be taken up by the leather, leaving nothing but water behind. Some tanners use a different method as follows: The skins and a quantity of hot water are put into the drum and run ten minutes. The drum is then stopped, the hot water drained off, and the fat-liquor put in; or the fat-liquor is poured in and, mingling with the hot water, accomplishes its purpose. The preliminary drumming in hot water warms the skins so that the fat-liquor can penetrate more readily. Personally the author considers heating the drum with live steam the better method. When the leather has been run in the fat-liquor forty minutes, it should be taken out of the drum, placed over horses to drain for at least twelve hours, then set out, oiled on the grain, and hung up to dry.

Receipt No. 1.—A good fat-liquor for glazed kangaroo is made of the following ingredients:

Fig or Olive Soap.....	1 pound.
Neatsfoot or Cod Oil	2 pounds.
Moellon Degras	2 pounds.
Caustic Soda	1 ounce.

Boil the soap in six gallons of water until it is dissolved; then add the oil and boil fifteen minutes; then add the moellon

degras and stir five minutes. The caustic soda dissolved in two quarts of water should be added last. Enough cold water should then be added to make twelve gallons of fat-liquor for from one hundred to one hundred and twenty-five pounds of leather. Apply to the leather at 125 degrees Fahr.

Receipt No. 2.—For one hundred pounds of leather make a fat-liquor of:

Soap.....	1½ pound.
Olive Oil	2 pounds.
Treated Cod Oil	2 pounds.
Salts of Tartar.....	3 ounces.

Boil the soap in a few gallons of water; add the oil and boil again for ten minutes; then add the salts of tartar dissolved in a little hot water. It is advisable to add enough water to make twelve gallons of fat-liquor and to use it at 125 degrees Fahr. If this quantity of fat-liquor makes one hundred pounds of leather softer than is wanted, the quantity of leather can be increased twenty or more pounds, or less fat-liquor may be used.

Receipt No. 4.—To make fifty gallons of fat-liquor use:

Palermo Fig Soap.....	20 pounds.
Wyandotte Soda.....	5 pounds.
Moellon Degras	100 pounds.

Boil the soap in twenty gallons of water until it is dissolved, then add cold water to reduce the temperature to 140 degrees Fahr., next add the soda and degras and without boiling stir the mixture five minutes. Fill the barrel up with water so that there are fifty gallons of fat-liquor. For one hundred or more pounds of leather use two gallons of this fat-liquor together with six gallons of hot water. After the leather has been drummed in the fat-liquor thirty minutes, rinse it in warm water containing some Wyandotte soda, let it drain twelve hours, then set it out, and hang it up to dry.

Receipt No. 5.—This is a good fat-liquor for dull kangaroo leather. For one hundred pounds of skins use:

Fig or Olive Soap.....	1 pound.
Neatsfoot Oil.....	4 pounds.
Moellon Degras.....	2 pounds.
Caustic Soda	1 ounce.

Boil the soap, next add the oil and boil again, and then stir in the degreas and soda. There should be twelve gallons of fat-liquor, and it should be used at 125 degrees Fahr.

Receipt No. 6.—This fat-liquor contains no oil or soap; nothing but moellon degreas and alkali:

Moellon Degreas	3 pounds.
Salts of Tartar	4 ounces.

Dissolve the salts of tartar in three gallons of hot water; then stir in the degreas, stirring for several minutes. Add water to make twelve gallons, and use at 140 degrees Fahr.

Oiling and Drying the Leather.—After the skins have drained at least twelve hours after fat-liquoring they should be struck out and oiled lightly upon the grain. For glazed finish use one part neatsfoot and three parts paraffine oils warmed and stirred together; or one part olive and three parts paraffine oils. For dull finish use equal parts of neatsfoot and paraffine oils. After the oil has been applied to the grain, hang the skins to dry in a moderately warm room with good circulation. It is best for the leather to let it dry rather slowly. When dry, the skins are dampened and staked.

Staking and Tacking.—The best way to dampen the dry skins is to put a dozen of them at a time into hot water, allowing them to remain about two minutes, then pack them into a box and cover the pile with a coat of wet sawdust about twelve inches deep. They should remain in this condition over night, then be staked and tacked on boards. When dry they are trimmed and seasoned.

Finishing.—An excellent glazed finish is obtained by using the following dressing:

Prepared Blood.....	15 pints.
Water	1 pint.
Milk	1 pint.
Glycerine	2 tablespoonfuls.
Orchil	$\frac{1}{2}$ pint.
Nigrosine Solution	$1\frac{1}{2}$ pints.
Ammonia	1 pint.

Make the nigrosine liquid by dissolving eight ounces of

black nigrosine in a gallon of water. Mix the ingredients by thorough stirring; then add enough strong logwood liquor to make nine gallons of finish.

Before applying the finish, the leather should be rubbed with a lactic acid solution made by mixing one part acid and eight parts water, to clear the grain of grease. When this has dried, the finishing should be put on and well rubbed into the grain; the leather is then dried and glazed; more finish applied to it, and again dried and glazed.

A solution of nigrosine and wood alcohol also clears the grain of greasy matter, and deepens the color. When this is used, the lactic acid solution is not necessary. Dissolve an ounce of black nigrosine in a gallon of hot water and to this add a small quantity of wood alcohol. Give the leather a coat of this, then dry, apply the finish, dry again, and then glaze.

The finishes described in the sections on goat, sheep and calf leathers are also suitable for kangaroo leather.

After the first glazing, the leather is given another coat of finish, dried, staked and then glazed again. A light coat of hot finishing oil is the finishing touch.

For dull finish give the leather a coat of seasoning, dry it, then apply another coat, dry again and iron with a hot iron, then stake the skins lightly, which will leave them feeling soft and full. The dull finishes described in the section on calf and goat leathers can be applied to kangaroo with equally satisfactory results.

If colored kangaroo is wanted, follow the instructions given for calf and goat skins.

VEGETABLE-TANNED KANGAROO SKINS.

Quebracho-Tanned Kangaroo.—In the manufacture of vegetable-tanned kangaroo leather, quebracho extract is used, also a combination of quebracho and hemlock extracts, one of quebracho and palmetto extracts, and either gambier or palmetto extract alone.

When quebracho extract is used a convenient quantity of it

is boiled with water in a barrel to form a stock solution from which the tan liquor is made up and strengthened. The first liquor to which the skins are subjected is a weak one, about eight degrees barkometer. The pickled skins are suspended in this liquor, which should contain some salt, and as the tanning progresses the strength of the liquor is increased until at the last it is about twenty degrees. The time required for tanning varies according to the thickness of the skins and the strength of the liquor. From seven to fourteen days are usually required. Salt should be used in quebracho liquor in which pickled stock is tanned to prevent the washing-out of the salt in the skins which would leave the acid to burn the fibers.

Excellent results are accomplished by using a mixture of quebracho and hemlock extracts in the same manner that quebracho is used by itself. A combination of seventy-five per cent. quebracho and twenty-five per cent. palmetto extracts makes a desirable tannage, the leather turning out soft, full and plump.

When the tanning is completed, the leather should be washed in lukewarm water, pressed and fat-liquored. A suitable liquor is made of one and one-fourth pounds of soap and two pints of moellon degreas for one hundred pounds of leather. The skins are run in this fat-liquor for thirty minutes, then rinsed in warm water, struck out and hung up to dry. The dry leather is then moistened with warm water, shaved, run in warm sumac liquor, struck out and dried again. The skins in a dry condition, are softened, and colored with logwood and iron or other liquor, dried, staked and finished.

A mixture of quebracho, alum and salt makes soft, plump leather. If the skins have been pickled it is necessary to remove the acid in a drench of sour bran and salt before tanning them. To every hundred gallons of quebracho liquor of four degrees barkometer strength add, while the liquor is warm, a pound and a half of alum and four pounds of salt, and plunge until it is well mixed. At the end of thirty-six hours the skins are ready for the second bath. Heavy stock may re-

main in the first bath forty-eight hours. The second bath consists of quebracho liquor of six degrees strength, gradually strengthened until the skins are tanned through. No alum and salt are used in the second bath. When taken from the liquor, the leather is rinsed in warm water, fat-liquored and dried, then moistened, shaved, colored and finished.

When quebracho and hemlock extracts are combined, the liquor should be two-thirds quebracho and one-third hemlock. The tanning is begun in weak liquor, which is strengthened as the tanning proceeds, until the skins are tanned through. Quebracho-hemlock and quebracho-palmetto tanned skins work out into fine leather when they are fat-liquored and finished in the following manner, which is a little different from the method previously described.

Finishing Combination-Tanned Leather.—When the skins are fully tanned, take them from the liquor and either press them to remove surplus liquor or let them drain in a pile for forty-eight hours: Heat the drum with steam, and put in the leather together with one gallon of any good leather oil to each one hundred and fifty pounds of it. Run the drum thirty minutes. Then take the leather out of the drum and hang it up to dry; after drying, weigh it, wet it in warm water in a tub and leave it in piles for twenty-four hours to soften. It should now be shaved; then put it into a drum together with just enough warm water to wet all parts alike; drain off any water remaining in the drum and add from sixteen to twenty gallons of fat-liquor at 110 degrees Fahr. to each 100 pounds of dry weight leather. Some tannages need more fat-liquor than others. Sixteen gallons is sufficient for most leather. Run the drum until the fat liquor is well taken up, then hang the leather up to dry. To make the fat-liquor, fill a barrel half full of water and boil in it twenty-five pounds of fig soap; then add fifty pounds of English sod oil and one and a half gallons of clarified leather oil, saponify thoroughly and add water to make fifty gallons of fat-liquor. The dry leather is then wet and colored. If blue flesh and black grain are wanted, it is drummed in an alkaline logwood

liquor, then grain-blackened on machine or by hand. If the leather is to be black clear through, the skins should be drummed in a solution of five ounces of titanium-potassium oxalate to one hundred pounds of dry leather, then in logwood liquor, after which a solution of five ounces more of the titanium salt is poured into the drum and drumming continued ten minutes; the leather is then washed, set out, oiled and hung up to dry for the final finishing.

Good leather is made by tanning kangaroo skins in a liquor made of gambier, alum, sulphate of soda and salt in the proportions of six pounds of gambier, two pounds of salt, one and one fourth pounds of alum, one pound of sulphate of soda and one-half ounce of picric acid for one dozen light skins. Boil the gambier separately; the other materials also separately and then mix the two solutions. The tanning liquor can be given to the skins in a drum, a gallon at a time, and they are drummed until tanned through. They should not be pickled, but tanned after bating and washing, and every trace of lime must be removed before tanning is begun. Suspending them in the liquor is a good way to tan them.

After the leather is tanned, it should be allowed to drain for several hours or pressed and then treated with cod oil emulsified by borax. The borax cuts the oil so that there will be no sticky grain. The leather is then dried, moistened and staked, colored and finished.

Sometimes skins that have been tanned with gambier or with palmetto are retanned with alum, salt and soda, then fat-liquored and dried. Tanning is effected with gambier in a vat and retanning in a drum. This process produces dongola leather.

Another form of dongola tannage consists of tanning first with gambier, then giving them a sort of kid tannage in a drum. One hundred medium skins, pressed from the tan, are given two pounds of alum, five pounds of salt, twelve pounds of flour, five dozen egg yolks, one-half pint olive oil and four gallons of water. The alum and salt are dissolved in two gal-

lons of water, then the flour is carefully stirred in. The egg yolks, previously mixed with warm water, are then added and the mixture is stirred and mixed very thoroughly. The skins are run in a drum until they have absorbed the mixture; then they are rinsed off, struck out and dried. Pickled skins should be neutralized before they are tanned in this process. A combination of gambier, flour, egg yolk and neatsfoot oil, thoroughly mixed and made into a sort of paste makes excellent kangaroo leather. No subsequent fat-liquoring is necessary, the skins being dried, wet back and shaved, colored and finished. One hundred medium skins, free from acid, require fifty pounds of gambier, five pounds of salt, two pounds of alum, twelve pounds of flour, five dozen egg yolks, one pint of oil and six gallons of water. The gambier is boiled and cooled, then the other articles are added as described above. When the skins are dry, they are wet shaved and colored yellow or blue or black upon the flesh, and black upon the grain, then dried again, staked and finished. Palmetto extract may be used in place of gambier. Skins tanned with palmetto may be retanned with alum, salt, egg yolk and flour, dried, wet, shaved, colored and finished.

Chrome-tanned skins, after washing and shaving, can be retanned with palmetto and then finished the same as pure chrome leather.

Yellow Flesh.—If yellow back is wanted on quebracho or combination-tanned leather, the skins, dried after fat-liquoring, are wet in a tub of warm water and placed in a pile to soften. Then, for every one hundred small and medium skins, a half pailful of sumac is scalded with hot water for two hours in a closed vessel. When ready for use, the sumac, four pailfuls of water, one gallon of lactracene and the skins are put into a drum, and drummed for twenty-five minutes. The temperature of the sumac liquor and water should be 110 degrees Fahr. After the skins have been drummed in the sumac-lactracene liquor for twenty-five minutes, the yellow dye is added and the leather run in it ten minutes. Dissolve one pound of Yellow S

in one-half barrel full of water and use three or four pails of the solution for each hundred pounds of leather weighed before softening. After the leather is colored yellow, color the grain with logwood and striker on the table or machine, then set the leather out, oil the grain with sperm oil, dry and finish in dull or glazed as may be desired.

Blue or Black Flesh.—Prepare the skins by softening with water, then run them in sumac, then in logwood and striker, which colors both flesh and grain. The exact treatment depends upon the tannage and condition of the leather. A good process is carried out in the following manner: Drum the softened leather in sumac; then for every hundred pounds of it weighed dry, run for ten minutes in a solution of five ounces of titanium-potassium oxalate; next pour the logwood-fustic liquor, slightly alkaline, into the drum and run the leather in it twenty minutes; then pour in another warm solution of five ounces of titanium-salts; run the drum ten minutes, then drain the liquor out, and wash the leather, set it out, oil the grain and hang up to dry. Coloring can also be done with logwood and copperas or other striker. Drumming the leather first in titanium salts, then in logwood and then again in titanium solution colors it black through flesh and grain.

A Patented Method of Finishing Kangaroo Leather.—An unstuffed kangaroo skin, tanned by a gambier, quebracho or other vegetable tanning process is fat-liquored with a suitable fat-liquor and then dried. The inner or flesh side is then colored blue-back by any suitable dye, and the grain is dyed black with logwood or other coloring material. The skin is then slicked out smooth and hung up and dried; then staked and trimmed in the ordinary way. It is then seasoned by the use of bluestone, iron, logwood, ammonia, blood and nigrosine, the proportions being as follows: Bluestone, one-half pint; iron, one-eighth ounce; logwood, one-half pint; blood, one pint; nigrosine, one-half pint. The seasoned skin is dried in a warm room, then glazed and staked, when it is given another coat of seasoning, dried and glazed again, and then staked in

the same manner as before. It is then again seasoned, dried and glazed, and is now ready for the market. The finished skin has a blue-black flesh, a jet black grain and a bright finish resembling glazed kid; and at the same time it is very soft and durable. This process of finishing leather was patented in 1899 by Christian E. and Henry A. Lappe, of Pittsburg, Pa.

SECTION EIGHT.

METHODS OF BLEACHING LEATHER.

Bleaching Sole Leather.—There can be no doubt of the fact that as much progress has been made by the tanners in bleaching as in any other department of leather manufacture.

Large concerns such as the J. B. Ford Company, Wyandotte, Mich., who manufacture Wyandotte Tanners Alkali and Wyandotte Tanners Soda have devoted much time and money to the development of proper bleaching methods, and their chemists and experts have proven formulas based upon the laws of cause and effect, which obviate the necessity of obtaining at the named cost in the school of experience the knowledge of the finer parts of the work, and which can be obtained from them at no cost to the user of their materials.

When once the laws governing the results of bleaching with given material are understood, the mystery with which it is frequently attempted to surround the "secrets" of the bleaching process are cleared, and it will be seen that the work is based upon common sense laws. A transgression of these laws will produce a result not included in the calculations, such as dark-colored grain or cracky grain. Usually the material used for bleaching is blamed for unsatisfactory bleach results when in reality the application of the material is faulty.

Some alkalies extract more weight than others. This statement will perhaps be questioned, but the J. B. Ford Company has on record data which proves this contention beyond doubt.

Undoubtedly the greatest consumption of bleaching material is by the sole leather tanners, and the accomplishments in that line are of great interest. With the coming into general use of tanning extracts the necessity of bleaching grew until to-day many of the Texas oak leather tanners bleach their "bloom"

oak product, and this general need brought out not only Wyandotte Tanners Alkali, which is by far the most efficient and most economical bleaching material made, but also the "dip machine" for bleaching leather.

This machine is in line with the progress made in bleaching. The apparatus consists usually of five vats in a row over which is built a hoist so that the leather hung into frames holding ten to twelve sides can be lowered simultaneously into the vats and raised again. The vats are usually built to hold one thousand gallons of water, and the frames constructed so that each side has allotted a four and one-half inches space.

The five vats contain usually: Vat No. 1, water; vat No. 2, alkali; vat No. 3, water; vat No. 4, sulphuric acid; vat No. 5, water. All should be heated to 125 degrees Fahr. except vat No. 1 which should be heated to 130 degrees Fahr. We advocate heating vat No. 1 to 130 degrees Fahr. as the cold leather upon being immersed usually lowers the temperature of the water from five to eight degrees. These temperatures should be maintained uniformly. It is essential that the temperature of the vat following the acid vat should be equally as warm as the latter. Some tanners use here a cold water bath instead of the temperature of the acid bath, preferring to have the leather come out stiff and hard; but this is wrong, as the leather coming from the acid bath carries with it quite a per cent. of free sulphuric acid which is sealed into it when it is placed into cold water, which contracts the fibers and retains the acid to the detriment of the quality of the leather.

The amount of alkali required for bleaching, varies according to the condition of the leather and color desired. For oak leather twenty-five to forty pounds of alkali to start with will prove sufficient, and for union tannages fifty to ninety pounds. For hemlock and combination tannages the quantity required will vary from seventy to one hundred and twenty pounds to start with according to the tannage.

The extracting, or stuffing leather with extract, must also be reckoned with and seriously, as the extract stuffed in by milling

consists of uncombined tannins and is more easily extracted than combined tannins. Therefore it would seem necessary that the tannin material used—the properties of the various combinations of tanning materials employed and the general condition of the leather should be taken into consideration, and then the amount of alkali required to meet these conditions be determined.

An alkali of given composition and strength is uniform and invariable in its action, and when varying results are obtained they are usually due to a failure to maintain in the tanning process uniform conditions. For instance, should a sole leather tanner increase the amount of chestnut wood extract in his combination of tanning material used, he is changing the conditions of the leather, and he must provide for this changed condition by changing his bleaching quantities.

Where conditions are maintained uniformly an alkali of given composition will invariably produce uniform results. The function of an alkali in bleaching is to liberate from combination a certain amount of tannin. This amount is governed wholly by the strength of the alkali solution used and the length of time the leather is immersed in it.

The amount of tannin thus released is later on cleared out by the action of the sulphuric acid. It is essential that the strength of the alkali and acid solutions should be strengthened during the day, preferably after each dip.

A portion of the alkali in the alkali vat enters into actual combination with certain tans and non-tans, principally the latter, that have been extracted from the leather, and such alkali is useless for further bleaching and must be replaced. Also, the alkali that has been absorbed by the sides and that which hangs on the surface and fails to drip off is lost and must be replaced.

The amount required to keep the bleach strength at its full efficiency may be calculated on the basis of ten per cent. of the amount used to start with, for every fifty sides bleached. Then, where eighty pounds of alkali are used to make up the solution

at the start, eight pounds should be used to strengthen for every fifty sides bleached. This amount may be divided into proportionate quantities and added to the solution after each dip, or the amount may be added to the solution after every four dips, that is, where the frames hold twelve to thirteen sides. But the former plan is preferable as it is most conducive to uniform results. The strengthening of the acid solution should be done on the same basis.

The amount of acid required depends upon the amount of tannin liberated by the alkali. On oak leather we find it takes two pounds of sixty-six degrees sulphuric acid to start the solution for every pound of Wyandotte Tanner's Alkali. On union and hemlock tannages five pounds of acid to start for every three pounds of Wyandotte Tanner's Alkali will suffice.

After the bleaching is successfully accomplished, desirable colored leather is not assured unless intelligent care is given the leather in drying. Poor color is often the result of careless handling in the dry lofts.

BLEACHING BAG, STRAP AND COLLAR LEATHER.

Much depends upon the condition of the leather throughout the tanning process in order to obtain a good color. The following single-bleach formula is giving great satisfaction: When the leather comes from the shaving machine run it, say thirty sides, in a drum with warm water until it is thoroughly wet, and then run the water off. Next run the sides in a solution of twelve pounds of common salt and fifteen gallons of warm water for ten minutes and discharge the water and salt, after which run them in a solution of three pounds of Wyandotte Tanner's Soda and fifteen gallons of water for fifteen minutes longer. Run off this solution and give the sides a five-minute rinse in clean water so as to remove from them all traces of the soda; then rinse for eight minutes in twelve gallons of water at 125 degrees Fahr., to which have been added one and one-half quarts of sulphuric acid. Drain the acid solution off and rinse the leather in clean water. Next run for one hour in

a solution of thirty-five gallons of palmetto or quebracho extract 16 degrees barkometer strength, and eight pounds of common salt. If a better color is desired, use sumac after retanning.

A still better color may be obtained by adding one-half pint of dissolved tin crystals to the sumac solution.

Double Bleach.—After the leather is split and shaved, retan it with palmetto or quebracho extract of 16 degrees barkometer strength, either in paddle wheel or drum. When retanned put thirty sides in a drum of warm water and drum for ten minutes. Then run the water off, and make a solution of twelve pounds of common salt and fifteen gallons of water, and run the sides in this solution for ten minutes more. Then wash off the leather with warm water.

Next prepare a dip bleach, using four barrels. In the first barrel use five pounds of Wyandotte Tanner's Soda and thirty-five gallons of water of about 125 degrees Fahr. In the second barrel use warm water of 125 degrees Fahr. This is for the purpose of washing the soda from the leather. In the third barrel use thirty-five gallons of water with sufficient sulphuric acid to bring the acid strength up to from 25 degrees to 28 degrees Baumé. In the fourth barrel use thirty-five gallons of water at about 80 degrees Fahr. The last barrel should be fitted with intake and overflow pipes so that the water may run freely through it, as the acid bath is very strong. After every fifteen sides bleached, strengthen the first barrel with one-half pound of Wyandotte Tanner's Soda, and the third barrel with one-half cupful of sulphuric acid.

When fifty or sixty sides have been bleached the solution in barrel No. 1 may be used in the drum and a new solution made for this barrel the same as in the beginning.

Rinse Liquor.—The soda liquor that was used in the first barrel may be employed in the drum as follows: After the salt has been washed from the sides put thirty of them in a drum and run for twenty minutes in ten gallons of this soda liquor to which have been added fifteen gallons of warm water. Then

wash well with warm water, after which use the dip bleach as given above, working the sides up and down three or four minutes in each barrel.

Lighter Color.—If a still lighter color is desired the sides may be treated with sumac in a drum or paddle wheel. Prepare the sumac as follows: In one-half barreelful of water dissolve six gallons of ground sumac, and steam for fifteen or twenty minutes. Turn off the steam and allow the sumac to cool. Dissolve a teacupful of tin crystals in two gallons of hot water and add one cupful of muriatic acid. When the sumac liquor has cooled, add to it the solution of tin crystals and muriatic acid. Run the sides in a drum in this solution for one hour. If a paddle wheel is used instead of a drum the process should be continued for a longer time. The leather should be kept in motion while in the sumac solution whether it be in the drum or paddle wheel. After the sumac process is completed the leather should be rinsed well with lukewarm water. Then set it on the flesh side. When dry enough to reset, put a thick coat of moellon-degras on the table, reset the leather, and give it a coat of neatsfoot oil on the grain side. Tack it on frames and when dry finish it.

BLEACHING WITH SUMAC, BORAX AND SULPHURIC ACID.

In the coloring and finishing of skins that have acquired a dark color from the tannage, it is advantageous to retan them with sumac, which not only puts the leather in good condition to be colored, but also makes it softer and more desirable in every way, especially when the skins are hard and firm from the tannage.

One way to do the work is to take the dry skins, moisten them by dipping them into warm water and placing them in piles for a number of hours to become moist and soft. They are then placed in a drum and washed in warm water containing borax for from fifteen to thirty minutes, when the water is run out and a fresh supply run in, and the skins washed again. Sometimes one washing is sufficient.

The leather is then treated with a weak acid liquor made up of water and sulphuric acid for twenty minutes, after which it is thoroughly washed in two or three changes of water. It is next treated with sumac, also in a drum, from one to two pounds of sumac being used for each dozen skins.

The temperature of the sumac bath should be about 100 degrees Fahr., and the skins should be drummed in it until they have absorbed all the tannin, when they are rinsed off and set out. They are now ready for coloring, or they may be dried out and colored later. For medium shades the above process is satisfactory, but for very light shades sugar of lead and sulphuric acid are often used.

BLEACHING WITH SUGAR OF LEAD AND SULPHURIC ACID.

These articles make the skins nearly white, but their use has unpleasant features. None of the coloring matter is removed from the leather, the light color being the result of the lead sulphate deposited on the grain. It is generally best to retan the skins in sumac before bleaching them.

To properly prepare skins for this process, they should be taken in the dry condition and thoroughly softened with warm soft water; they should then be milled in a drum in warm water containing borax until all particles of dirt, dust and free tannin are removed. The next process is retanning with sumac, which is also done in a drum.

The quantity of sumac required by a lot of leather is determined by the size, thickness and condition of the skins, and ranges from one to two pounds for each dozen. The sumac liquor should be at a temperature of 100 degrees Fahr., and the skins should be drummed in it until they have absorbed all the tannin, after which they are bleached.

The bleaching may be done either in a drum or a vat by running the skins in a sugar of lead solution of about two and one-half per cent., for thirty minutes, then transferring them to a bath of sulphuric acid of about three per cent., and leaving them therein until they become white. The operations may be

repeated as many times as may be considered necessary to get the skins bleached. It is very important that all traces of acid be removed from them before any dye is applied. Glauber's salt may be used in place of acid.

Many of the bleaching processes have undesirable effects upon the leather, making it harsh and brittle. As little bleaching as possible should be done. It is better to tan in clean liquor that makes leather of light and uniform color, such as liquors made from quermos and palmetto extracts, than to use a dark tannage and to depend upon a bleaching process to improve the color. Light leather intended for colors is improved by being run in an alum and salt solution immediately after the tanning is completed. This serves to lighten up the color by clearing the grain as well as strengthening it.

Nearly all classes of leather are improved by treatment with sumac before applying any dye. Sumac combined with lactacine makes an excellent mordant.

Clouds and streaks may be removed by drumming in oxalic acid solution just before coloring, the skins being afterward washed to get rid of the acid.

A greasy grain is made clear and open by the use of a weak lactic acid solution in which the leather is drummed previous to dyeing, then washed and colored. All classes of skins, but especially greasy ones, are improved by treatment with lactic acid.

BLEACHING WITH GOLD DUST WASHING POWDER AND ACID.

Hides and skins for bags and case purposes, as well as for any other colored leather, may be bleached with Gold Dust Washing Powder and sulphuric acid in the following manner: After they are tanned or retanned and drained, put the hides or skins together into a drum with a solution of the powder made by dissolving one and a half pounds of it in fifty gallons of warm water. This is sufficient for fifty sides or one hundred skins. Drum the leather in the solution for twenty minutes; then wash it off in clean cold water for ten or fifteen minutes. Then

add one pint of sulphuric acid and eight pounds of salt to fifty gallons of cold water and run the leather in this liquor for fifteen minutes, after which wash it for fifteen minutes in cold water. It is then ready to be fat-liquored. If the soap in the fat-liquor darkens the leather, drain the drum and run it in fifty gallons of cold water into which one quart of lactic acid has been stirred. It is next set out with a rubber slicker and hung up to dry, and then finished according to the kind of leather that is wanted. The heavy loading of leather with extracts makes some process of bleaching necessary. This process consists of removing the surface tannin with alkali and then brightening it with sulphuric acid. After bleaching, it is necessary to wash out the acid so that it will not injure the color nor the fibers of the leather.

Bleaching is done most expeditiously in a drum as more can be accomplished in it in thirty minutes than in a vat in an hour.

BLEACHING WITH HYDROSULPHITES.

Hydrosulphite compounds are used for bleaching leather in the following manner: Dissolve one pound of hydrosulphite in fifty gallons of water or weak tan liquor in a suitable vat, and stir until well mixed. As soon as the bath is prepared the skins should be suspended in it for about one hour. Then they are removed therefrom, rinsed and dried. The hydrosulphite solution should always be prepared immediately before it is used.

Hydrosulphite may be bought ready for use, or may be prepared as follows: Ten parts of zinc dust are stirred up with fifty parts of water, in which a little ice has been dissolved. One hundred parts of sodium bisulphite are then added slowly, and with constant stirring, to the solution of zinc dust. The temperature of the mixture while it is being prepared should not rise above 50 degrees Fahr. After it has been stirred for several minutes the solution should be allowed to settle. The clear solution is then diluted and used.

BLEACHING WITH BISULPHITE OF SODA.

Naturally dark-colored leather can be improved in color by bleaching with bisulphite of soda and hydrochloric acid. The bath is prepared by adding six pounds of liquid bisulphite of soda or potash to twenty gallons of water. To this solution add slowly from one to two pounds of commercial hydrochloric acid, previously diluted by being mixed with an equal volume of water.

Bring the skins into the bath, prepared as directed, and stir them about until they are bleached throughout. A little more acid may be added to the bath if the skins seem to require it. The process is conveniently carried out in a vat, paddle or drum. Bisulphite of soda in liquid form contains from sixteen to eighteen per cent. of sulphur dioxide, hence its employment as described. The addition of the hydrochloric acid to the solution liberates the whole of the sulphur dioxide gas.

BLEACHING WITH SODIUM PEROXIDE.

To bleach with sodium peroxide, add two pounds of concentrated sulphuric acid to twenty gallons of water in a suitable tub; then add slowly, and with constant stirring, sprinkling it into the solution, sodium peroxide, until the acid is neutralized, which may be ascertained by testing with a piece of red litmus paper.

Use the bath as soon as prepared, and immerse the skins to be bleached in it for several hours.

BLEACHING WITH PERMANGANATE OF POTASH.

Permanganate of potash used in conjunction with sulphurous acid provides an efficient bleach for vegetable tanned leather. The process consists of two baths. The first bath is a solution of permanganate of potash, made by dissolving from four to six ounces of the salt in one hundred gallons of water. The leather is immersed, preferably by suspension, in this solution for thirty minutes; it is then transferred to a solution of sulphurous acid. This is prepared with sulphur dioxide gas, which

can be purchased in liquid form in a copper container. The sulphurous acid bath is made by connecting the cylinder or copper container to the vessel containing the water for the bath and charging the water with the sulphur dioxide gas. The skins are left in this bath until they have assumed the requisite light shade. The effectiveness of this process is due to the strong oxidising action exerted on the leather by the permanganate of potash. A great deal of care must be exercised in using this bleach, as there is danger of injuring the leather.

Leather can also be bleached in the sulphurous acid bath, prepared in the manner that has been described.

BLEACHING, STUFFING AND FINISHING RUSSET SKIRTING LEATHER.

Take some forty sides, twelve to eighteen pounds stock, right from the liquor and have them skived and leveled. Then put them into the sumac vat and leave them for two hours to fill up and color. The vat should measure five by nine feet and should be filled within one foot of the top. Put in one bag of dry sumac. Sicily sumac should be used as it produces the best results.

Heat the liquor to 120 to 130 degrees Fahr. Instead of the slow process of using a vat, the sides can be bleached in less time in a drum. Put three pailfuls of dry sumac into one-half barrel of water, heated to 140 degrees Fahr., then put this into the drum together with the leather and set the drum going. A short time will be all that is required.

Whether put in a vat or drum, the sides should be taken out in due time and placed over night to drain, or the moisture can be forced out by pressure, and they are then ready for bleaching. This can be done in a drum as it is highly important to get a good, light-colored base which will suffice for either russet or colored stock.

Beside the drum, put a barrel holding fifty allons, and into this drop eight pailfuls of dry Sicily sumac and fill the barrel half full of water. Heat for half an hour at 160 degrees Fahr., and

then add four pounds of muriate of tin, which should first be dissolved in a pail of boiling water. Fill up the barrel with water and heat the liquor to 125 degrees Fahr. Throw the forty sides into the drum and start it going, and through the open door throw in a pailful of the sumac liquor at a time until there is enough to thoroughly soak the leather. Drum one hour, then pull the plugs and let the liquor run out.

Next put twenty-two ounces of sulphuric acid into a half barrel of water and re-bleach the leather in it by throwing this solution into the drum and running for five minutes. This washing takes out all the rust, emery and bark stains. Then rinse the leather by pouring cold water into the drum and wash for ten minutes. This completes the bleaching. The leather is then dried, soaked in cold water and packed down over night to be ready to be prepared for stuffing the next morning.

To stuff the leather, the following process is recommended: For forty sides averaging sixteen pounds to the side, use forty pounds of wax, three pounds of tallow and twenty-five pounds of cod oil. After the leather is stuffed, set it out by hand and give the grain a coat of hot neatsfoot or sod oil. When dry, turn and reset it on the table by brushing it on the grain side with hot water. Take it over to the stoning jack and stone all over, giving particular attention to the rough heads and grainy places. After the stoning, take the leather back and reset on flesh and grain, then hang it up for final drying. It will then be in good condition to be stained any shade of color.

For russet alone, the leather, after being dried, should be sized on the flesh side with Irish moss solution, and rolled while damp. When dry, size the grain with heavy flaxseed water (one pailful), to which should be added four ounces of gelatine. Roll while damp, and either glaze or dry finish it.

BLEACHING WITH BORAX AND LACTIC ACID.

Combination-tanned stock that is to be colored for Russia and other colored leather is bleached and cleared by the use of borax and lactic acid. Commercial lactic acid may be used

or bran may be soured, and the acid obtained in that way. Put one bushel of rye bran into a barrel filled with water, and let it stand until it is fermented and sour; it is then ready for use. One hundred pounds of dry leather that have been previously fat-liquored require about three pounds of borax and two pailfuls of the sour bran liquor. The leather should be moistened and softened by dipping it into hot water and leaving it in piles until it is soft; then it should be put into a drum together with six or seven pails of water at 90 degrees Fahr. Put the water and the borax solution into the drum together with the leather and drum ten minutes. Then the bran liquor should be thrown in and the drumming continued for fifteen minutes. When this has been done, wash the leather thoroughly and, as a bottom for the color, give it some wood dye, such as fustic, peachwood, hypermic, etc. After coloring use alum to set the color. This is a safe and efficient process, as it has no bad effects upon the leather. The borax cleanses and saponifies the fat or grease that may be in the grain, and the lactic acid clears the grain and opens it so that the coloring material can readily penetrate and produce deep and uniform coloring.

When commercial lactic acid is used, two gallons are dissolved in fifty gallons of warm water, and the solution is poured into the drum after the leather has been run in the borax bath.

CLEARING LEATHER WITH ALUM AND SALT.

Leather that is to be colored some fancy shade is benefited by being cleared in a drum with a solution of alum and salt. This process is especially good for Russia leather. The leather is taken in dry condition and softened with warm water. It is then put into the drum together with six pailfuls of warm water and two quarts of alum and four quarts of salt for one hundred pounds of dry leather. The drum is run fifteen minutes; the leather is then washed for ten minutes and given the first fat-liquor, preferably acid fat-liquor or sulphonated oil, when it is again dried, colored and fat-liquored. The alum and salt should

be dissolved in warm water before being put into the drum. They improve the color and texture of the leather by cleansing and clearing the grain. When colored, the dye strikes through the leather and becomes permanent. This process is used more upon combination tanned Russia leather and leather for fancy colors than upon bark-tanned leather, as it is so simple and harmless. More alum and salt than the quantities mentioned may be used with perfect safety. The main fat-liquoring should be done after the leather has been dyed and dried so that the coloring will be well set.

BLEACHING WITH OXALIC ACID.

Oxalic acid is an efficient bleach for russet and colored leather. To make a barrel of bleaching liquor dissolve by boiling in three gallons of water one pailful of oxalic acid, and in three gallons of water in another vessel dissolve two pailfuls of salt. Put the salt solution into a barrel containing ten gallons of water and then add the oxalic acid solution and fill the barrel up with water to make fifty or more gallons of liquor. Leather is treated with this liquor after it is tanned or split and retanned. Fifty sides or ninety to one hundred skins should be given two pailfuls of oxalic acid and salt solution and seven pailfuls of water and be drummed in the liquor for fifteen minutes. If the leather is not clear enough on the grain for russet leather, a little more oxalic acid solution should be used. Tannages vary so much that more or less liquor has to be employed to meet the requirements. Some tannages need less bleaching than others.

After the leather has been bleached it should be washed in warm water until all traces of acid are removed. It is advisable then to scour it on the flesh side, press it, and hang it up to dry. The subsequent processes are fat-liquoring and coloring according to the kind of leather that is being made. Good russet leather is made by stuffing and drying the sides or skins, then buffing the grain and coloring with suitable dye, such as cake nankeen. The less color used the lighter the shade. Two

coats of color are applied with a soft brush, the leather is wiped off with a sponge and hung up to dry, and then finished as may be desired.

Oxalic acid and tin crystals make an effective bleach for bark-tanned leather. About eleven ounces of the acid and five and one-half ounces of the tin crystals will bleach one hundred pounds of dry leather. The acid may be used alone, but it produces the best results when combined with tin crystals. The leather should have been fat-liquored and dried; then dampened and put into the drum together with six pailfuls of warm water and the acid and tin crystals dissolved in a pailful of hot water, and drummed twenty minutes. Then it should be very thoroughly washed and given some wood dyestuff as a bottom for the color, and some set after coloring. This process makes a very clear grain on which beautiful shades can be obtained, but the leather is made somewhat harsh and the color does not penetrate very deeply; it is more desirable for bark-tanned than for combination-tanned leathers.

BLEACHING CHROME LEATHER.

Chrome leather is bleached by running it in a hot borax solution for a quarter of an hour and then in sulphuric acid solution for the same length of time; it is then washed in water and fat-liquored. The leather is made white by this treatment. Milling it in flour and water before fat-liquoring also bleaches it.

BLEACHING WITH TANNING MATERIAL, ALKALI AND ACID.

A process of bleaching with tanning material and alkali and sulphuric acid is carried out in the following manner: A bleaching liquor is prepared by making an aqueous solution of tanning material in any well-known manner, the strength of the solution depending upon the character of the leather and the tannery practice. In this process the bleaching solution should preferably be of the same or of greater density than the tanning liquor to which the leather was last subjected in the preceding tanning process.

A certain amount of alkali, or of a combination of alkaline ingredients, is added to the solution of tanning material. The quantity added should not only be sufficient to clarify the solution or dissolve the undissolved constituents naturally present in the tanning material, but there should be such an excess of it as to insure the bleaching effect of the dye, that is, the color which it is desired to impart to the leather, and according to the nature of the tanning material used. For securing leather of light colors the proportion of alkali must be greater than when dark colored leathers are desired, and if the bleaching liquor is formed of the solution obtained from a bark, the proportion of alkali should be less than if it is made from other materials such as quebracho extract, etc. The mixture thus obtained is heated, preferably from 100° to 140° Fahr., and during the treatment maintained as nearly as possible at a uniform temperature, and also at a uniform strength or density by the addition, at intervals, of such quantities of tanning material and alkali as are required for this purpose.

The leather is immersed in the bleaching liquor, and is maintained therein for a short period of time, say from one to ten minutes or more, according to the character of the leather and the effect desired, the immersing being continued for a greater length of time to secure a denser product. By the term alkali is understood an alkali, alkaline salt, or combination of alkaline ingredients, as for instance, sodium carbonate or borax, or combinations thereof.

After the bleaching in the alkaline bath, the leather is transferred to an acid bath. This acid bath consists of a weak aqueous solution of any suitable material or of an organic acid such as sulphuric, hydrochloric or oxalic acid, or a combination thereof, the solution varying in strength according to the character of the leather and the density of the bleaching alkaline liquor previously used. It should, however, be maintained as nearly as possible at a uniform strength during the treatment of the mass of leather to secure uniform results. The acid bath, as before stated, is preferably maintained at as

nearly a uniform temperature as possible, from 100° to 140° Fahr., and the leather is immersed therein and allowed to remain a sufficient length of time to acquire the color and properties desired, a lighter color and heavier leather being obtained the longer immersion is continued. After the acid treatment the leather is removed, drained, and washed with water to remove the acid. If it is desired to modify the color after the acid treatment, the leather may be immersed in a solution of tanning material, either with or without the addition of alkali, and be allowed to remain therein until the desired color and effect are obtained. This may be done before the leather is washed with water.

In bleaching hemlock-tanned sole leather the procedure is as follows: Assuming that the tanning liquor in the last layer from which the leather is taken has a density of 40° barkometer, an alkali bleaching bath is prepared of a density of 45° barkometer, by dissolving ninety-two pounds of quebracho extract, fourteen pounds of borax and twenty-eight pounds of sodium carbonate in every ten cubic feet of water (625 pounds). This bath is heated to 140 degrees Fahr., and the leather, taken directly from the last layer in which the tanning operation has been completed, is immersed in it for five minutes, whereupon it is removed, drained for a few minutes, and then immersed in the acid bath. Five pounds of sulphuric acid are dissolved in ten cubic feet of water, and this solution is also heated to 140 degrees Fahr. In this acid bath the leather remains for five minutes, whereupon it is removed and thoroughly rinsed in cold water. When operating upon a large number of sides, it is necessary to strengthen from time to time both the alkaline bleaching bath and the acid bath. In practice the density of the alkaline bath may fall to 40° barkometer, whereupon a sufficient quantity of very concentrated aqueous alkaline solution of quebracho extract must be added containing the same ingredients as the alkaline bleaching bath and in the same proportions until the density of the alkaline bleaching bath again becomes 45 degrees barkometer.

The acidity of the acid bath is maintained by adding after every fifty sides which have been immersed therein, from three-tenths to five-tenths of a pound of sulphuric acid to every ten cubic feet of water. If it is now desired to impart to this bleached leather an oak color, it is immersed in a liquor made from oak bark having a density of 40 degrees barkometer and a temperature of 100 degrees Fahr., and allowed to remain therein until the desired color is obtained.

The above-described treatment results in very material advantages over the ordinary process of bleaching. First, the leather, instead of being reduced in weight, is maintained or increased in weight, and consequently is of greater density resulting in greater durability of the articles made therefrom. Secondly, the bleach, instead of being merely a surface bleach, is one that may be prolonged so as to affect the entire fiber of the leather, and articles made therefrom will not vary in color from the effects of wear. Thirdly, it is practicable, by varying the strength of the solution, to produce any desired shade, and, therefore, to operate upon a mass of leather with uniform results in this respect. It is always preferable to make use of an alkaline bleaching bath in which the proportion of tanning material is greater than that from which the leather was taken in the preceding operation, but it is possible to carry out this process with a bleaching solution in which the tanning material is in less proportion.

The use of a bleaching solution consisting of tanning material, however, in connection with a sufficient quantity of alkali to produce the bleaching effect, instead of reducing the weight and density of the leather as usual, will maintain or increase it; and in proportion as greater weight is needed it is desirable to increase the proportion of tanning material and alkali in the solution.

The particular ingredients used, the proportions of the same in the baths, and the density and temperature of the baths may be varied and depend upon the tannery practice. This process is patented by Messrs. W. H. Krug and E. J. Haley.

A writer in *The Shoe and Leather Reporter* describes his method of bleaching sole leather by hand in the following words: "Have two rows of boxes, four feet wide, five feet deep and fifty-six feet long. Have in the center four boxes, 4 x 4, two for soda and two for acid. Six men on each row of boxes, twelve men in all. Take the hides from the machine and hang in front of a box in cold water. Heat the soda boxes to 125 degrees Fahr.; the acid the same. Put in the first soda box twenty-two and one-half pounds soda ash, in the second soda box two and one-half pounds. In each acid box put thirty pounds sulphuric acid. Hand eight sides to each box, remaining five minutes to each soda and acid box suspended on sticks. Pull from the acid in clear cold water in the end long box and leave in the box until filled. Then commence taking out, at the same time replacing from the acid box the space you are taking out from. Strengthening can be done with four pounds of soda and eight pounds of acid after every forty sides. When taken from the bleaching box, put through the wringer, oil by wheel, using one and one-quarter pounds oil to the side. One-third mineral and two-thirds cod oils makes a fine mixture and gives good results."

BLEACHING AND FINISHING RUSSET LEATHER.

After the leather is split by a belt knife, retan it in the usual way, and when it is tanned take it to the scouring machine and scour it well on both sides. Twenty-five sides make a convenient-sized pack to handle. Put them into a drum. The drum should have at least a dozen plugs in it. Put the twenty-five sides into the drum, close the door and run in through the axle forty gallons of water containing borax.

Prepare the borax solution before it is to be used, by adding ten pounds of borax to fifteen gallons of water. Boil until the borax is dissolved, then run in cold water to make forty gallons and to cool the solution. Start the drum as the borax solution is being put in; allow the drum to run twenty or thirty minutes, then remove the plugs and run it ten minutes longer. At

the same time run in lukewarm water through the gudgeon or through the door. Care must be taken not to have the water over lukewarm or the leather will be spotted. After a few minutes it can easily be seen whether the water coming from the drum is getting clear; then leave the leather in the drum and give it a strong solution of sulphuric acid made as follows: Take a barrel of cold water and put in enough acid to bring the solution to 30 degrees Baumé, or until it will bite the tongue. Let the sides run in this ten minutes with the plugs in, after which remove them and pour the acid water out of the drum while in motion. At the same time, throw in some water until no acid can be detected by the taste in the water coming from the wheel.

The leather should then be sumacked in a drum or paddle vat. Good sumac must be used as a poor quality of it will leave iron spots. Make the sumac bath strong and hot and add a handful of salt to the liquor. If a drum is used, run the leather in the sumac liquor one-half hour, then rinse it in clean warm water and slick out the flesh. In a paddle vat, sumac the leather two or three hours. Keep it in motion and warm up the liquor when it gets too cool. After sumacking rinse the leather in lukewarm water, and a nice russet is the result, ready for colors or russet.

If the leather is to be colored, the twenty-five sides can be colored at one operation. Dissolve the dye in boiling water. Add eight pailfuls of warm water to the drum, put in the leather, add the dye liquor slowly and carefully, and run the sides in it thirty minutes; rinse them in warm water and horse up for three hours, then fat-liquor.

If russet leather is wanted no coloring is necessary. Give light fat-liquor, dry and finish.

Colorless Dressing for Russet Leather.—To five gallons of water, add one-fourth ounce bichromate of potash, one pint of acetic acid, one gallon of egg albumen solution. Mix all together and keep in a cool place.

Another receipt is: Dissolve four ounces of blood albumen

in one gallon of water over night. Cook four ounces of granulated gelatine in one gallon of water and let it cool. Mix half a pint of white varnish shellac with half a pint of ammonia. Mix these materials together, and add enough water to make three gallons. This can be put on with a sponge, and it will make a handsome glaze.

For a plain natural finish give two coats and roll well when wet, then hang up to dry. Now give another coat. If this finish is made up a week before it is used, it will be all the better, as the ammonia will evaporate and fancy colors will be less apt to be spotted. Less ammonia should anyhow be used for colors.

BLEACHING MILL-STUFFED HARNESS LEATHER.

Place a barrellful of clear water at each end of the table. Heat the water in one barrel to 140 degrees Fahr., and keep the water in the other as cold as possible. Throw a pailful of cold water over the table to prevent the grease from sticking to it. Put a side of leather on the table, flesh side up, and throw a pailful of hot water on the side in such a way that the water will spread all over it as nearly at the same time as possible. Then brush over with oxalic acid solution made by dissolving two-thirds of a common teacupful of acid in a pailful of water, two and a half or three gallons of water heated to about the same temperature as the water being a pailful. Throw about one pint of the liquid on, right after the hot water, and brush over as quickly, and throw on a pailful of the cold water as soon as the acid has been rubbed in with the brush, which chills the flesh and prevents the hot water and acid from bringing the grease back to the surface. Apply the cold water in the same manner as the hot, so as to chill the whole side at the same time. Then glass the flesh over and hang the side up to dry. Sides that are bleached should be hung far enough apart so as not to touch each other before drying, and they will then dry out an even color.

It is not necessary to slick the flesh out after the hot water

is applied. The amount of grease that can be slicked out of the flesh after hot water means just so much loss to the weight of the side. Throw a pailful of cold water on the table after each side is bleached, and slick the table off so as to take off any acid that may be on it, which will take off the black as soon as it comes into contact with it. This process is a very satisfactory one, and two men can bleach one hundred and forty or more sides in a day.

SECTION NINE.

THE TANNING OF FURS AND HAIR SKINS.

Dry Tanning.—Furs and hair skins can be easily and satisfactorily tanned in the following manner: Prepare the skins for tanning by beaming and scraping them on the flesh side until they are free from flesh and greasy matter. They should not be soaked at first. Soaking and softening is done with wet sawdust. Soak some sawdust in water. Spread the skins out smoothly, flesh side up, and spread the wet sawdust an inch deep on the flesh side and let them lay until they are softened. In the case of greasy skins that are soaked in borax water and washed in warm sal soda, this treatment with wet sawdust may be omitted; others should be softened with it. When soft they are ready to be tanned.

Prepare a tanning paste of alum, salt and oatmeal. Take one gallon of rain water, heat it and stir in enough pulverized alum to make a very puckery solution; then add one-half as much salt as alum, and boil until the alum and salt are dissolved. While the solution is boiling, add one-half pound of oatmeal or rolled oats, boil fifteen minutes, and then set the paste aside to cool. By adding a few ounces of gambier to the liquor and boiling together, the skins may be given a light-yellow color.

The cleaned and softened skins should be spread out on a table, flesh side up. Use a brush or a swab of wool and spread on the tanning paste, giving a heavy coat all over each skin. Repeat this painting process each day until the skins are tanned, which takes from two to six days, according to their thickness. Light skins tan in two or three days; heavy ones require five or six days.

When the skins are tanned hang them up to dry in a shady

place or in a warm drying-room. After they have begun to dry they should be stretched and worked with some kind of a staker so that when dry they are also soft and white. No soaking or washing is necessary, but when dry and soft the fur should be cleaned with dry, hot sawdust. If a perfectly clear flesh is wanted, buff on an emery wheel.

Cleaning the fur can be done in a drum or cage when a great many skins are to be cleaned; on a small scale they can be tramped on or pounded in a barrel or tub, or they can be cleaned by brushing the hot sawdust into the fur with the hands and then beating it out with a switch until the fur is bright, clean and fluffy. Hardwood sawdust is better for the purpose than pine. When tanned by this process the skins are very soft and the fur is fluffy and clean. It is best to keep the hair side dry by keeping the skins out of water during the entire process, unless they are greasy, when it is necessary to wash them in warm sal soda water.

A good formula for the tanning paste is:

Pulverized alum.....	1 pound.
Salt	$\frac{1}{2}$ pound.
Rolled oats	1 pound.
Water	1 pailful.

Tanning with Bran, Alum and Salt.—Mix bran into soft water until there is enough of the mixture or liquor to cover the skins. Put them into the bran water and keep them covered for twenty-four hours; then remove them, wash them clean and carefully scrape off all flesh. Prepare a tanning liquor by dissolving one pound of alum and one-half pound of salt in one gallon of hot water. When the liquor is cool put the skins into it for twenty-four hours, then dry them and rub well or work them out soft. Immerse the skins again in the liquor for twenty-four hours, then dry them as before. Then immerse them in a mixture of oatmeal and warm water, or of flour and water for twenty-four hours, then dry and work them out soft. This makes them white and soft and fit for immediate use.

Flour in the Tanning Paste.—To get a white flesh on the skins it is advisable to use flour in the tanning paste. Prepare a solution of alum and salt and stir in enough flour to make a paste. Apply the paste every day for three or four days, then hang the skins up to dry. The drying and softening should be done together so that when dry the skins are also fully worked out and soft.

Tanning with Gambier, Alum and Salt.—Furs and hair skins can be nicely tanned in a combination process of gambier, alum and salt. They are first put into a fairly strong solution of alum and salt and left in it twenty-four hours. They are then transferred to a gambier liquor not over three degrees barkometer strength and handled every three hours until the strength is down to one degree. Then a six-degree liquor should be used and the skins handled every few hours until they are tanned through. The alum fastens the hair at once and prevents it from falling out during the gambier tannage. The alum-tanned skin absorbs the gambier very rapidly, and the process makes it very soft without the necessity of using very much grease. Other vegetable tanning material may be used in place of gambier, such as quebracho, hemlock or palmetto extract.

When tanned the skins should be washed, dried and made soft and smooth on the flesh side, after which a solution of oil and soap should be applied. Boil five pounds of castile or other soap in a gallon of water, add a quart of paraffine oil, mix thoroughly and apply a light coat to the flesh side of each skin. When dry, run the skins in sawdust and then in a slat wheel or cage to clean them and make them soft.

Washing Greasy Skins.—Such skins as raccoon and dog and others that contain a good deal of grease should be washed in a warm solution of sal soda and then scraped over the beam to rid them of as much of the grease as possible before they are tanned. Dogskins should be fleshed before they are soaked as they then flesh more easily than after soaking. After they have been fleshed they are soaked and washed preparatory to being

tanned. Dry skins are quickly and safely soaked and softened in water containing borax. Borax may be used in sufficiently large quantities to remove much of the oil and grease without the slightest injury to the skins.

Furs and hair skins should be soaked for a short time only, so that the hair will not slip. Greasy skins should be scraped or fleshed before they are soaked, but if they are dry a little soaking in lukewarm borax water will be helpful.

To wash greasy skins prepare a warm solution of sal soda by dissolving sal soda in water heated to 90 degrees Fahr. Dip the skins into this solution long enough to get them wet and hot, then put them on the beam and go over them with a flesher or dull knife, bearing down hard and forcing the grease out. The dipping and scraping may be repeated until the skins are free from grease; next wash them in cold water, let them drain and then tan them. Skins that are not greasy do not require washing in soda water but they should be free of flesh, lumps of fat and blood.

Chrome-tanned Furs and Hair Skins.—The best way to tan furs and hair skins by a chrome process is with one-bath chrome liquor. The skins will work out soft and strong, and they will always remain soft no matter how often they are wet. The fur can be colored just as readily as though the skin was alum-tanned. A good process of tanning is carried out in the following manner:

The skins, thoroughly softened, fleshed and washed, are put into a strong solution of alum and salt. To make this, two and one-half pounds of alum are dissolved by boiling in five gallons of water and one pound of salt is added and dissolved. When the solution has cooled down to 75 degrees Fahr., the skins are put in and stirred about for one-half hour and then allowed to remain in the solution from twelve to twenty-four hours, when they will be struck through with the alum liquor. They are then taken out, and three pounds of salt and some concentrated chrome liquor are added to the alum solution. Enough chrome liquor should be added to make a three or four per cent. liquor,

that is, three or four gallons of chrome liquor to one hundred gallons of water. As the skins absorb the tanning material, more concentrated chrome liquor should be added, and they should remain in the bath until they are tanned through. When the green color has penetrated through the thickest skins a few ounces of bicarbonate of soda should be added to the liquor and the skins left in one day longer; they should next be washed first in borax water and then in clear water, and finally hung up to dry. As soon as the excess of water has drained off a paste of soap, oil and flour is applied to them, and they are then dried, staked, softened and cleaned.

Another process consists of pickling the skins with sulphuric acid and salt, and then tanning them in a chrome bath. The pickle is prepared by dissolving eighty pounds of salt and three quarts of sulphuric acid in one hundred gallons of water. Light skins are stirred about in this liquor fifteen minutes, and then allowed to remain in the liquor over night; heavy ones and hides are left in the liquor twenty-four hours or longer. After they are pickled, they are allowed to drain twenty-four hours before they are tanned.

To make up the tanning bath, fifty pounds of salt and five gallons of concentrated chrome liquor are added to one hundred gallons of water, the solution being thoroughly stirred and plunged before the skins are put in. A paddle wheel should be used for the process. At the end of two or three hours more chrome liquor should be added, and more again at the end of a few hours. The skins are allowed to rest in the liquor over night, and the next morning more chrome material is added, making in all from fifteen to twenty gallons to one hundred gallons of water. Skins tan thoroughly in two or three days, while hides require four or five days.

The tanned skins are horsed up twenty-four hours. They are then put into a mill together with a solution of carbonate of potash made by dissolving one pound of it in fifteen gallons of water, and washed therein for one-half hour. They are then washed ten minutes in clear water, partially dried, painted with a mixture of soap, oil and flour, dried and staked out soft.

The pickle liquor can be used for twelve packs of skins by adding fifty pounds of salt and two quarts of sulphuric acid to one hundred gallons of liquor for each pack. After twelve packs have been pickled, a new liquor should be prepared.

The tan liquor can be used for twelve packs of skins by adding twenty-five pounds of salt to each one hundred gallons of liquor and then using fifteen gallons of concentrated chrome liquor for each pack. After four packs have been tanned, eight ounces of carbonate of potash should be dissolved and added to the liquor to neutralize the acid that has accumulated.

After twelve packs have been tanned, a new liquor should be prepared. The paste that is applied to the skins is made of olive oil soap, three pounds; neatsfoot oil, one gallon; water, ten gallons. Boil the soap in the water until dissolved, then add the oil and boil ten minutes. Allow the solution to cool to 90 degrees Fahr., then stir in flour until the paste is smooth enough to spread evenly. Apply this to the skins when they have dried a little or after they have drained well, then dry and stake them and run them in sawdust to clean them. Any good chrome fat-liquor may be applied to the skins with good results. Another good tanning process is as follows:

Equal parts of borax, saltpetre and Glauber's salts (sulphate of soda), about one-third of an ounce for each skin, are made with water into a paste, and this is spread over the inside of the skins, more being applied on the thick than on the thin parts. The skins are folded together and left in a cool place for twenty-four hours, then they are scraped and rinsed off and the following mixture applied in the same manner as before: One ounce of either sal-soda or borax, two ounces of hard white soap, melted slowly together without being allowed to boil. They are left with this mixture upon them for twenty-four hours. After this they are put into a solution composed of three ounces of alum, six ounces of salt, dissolved in sufficient hot water to cover them. When this liquor is cooled down to ninety degrees Fahr., they may be immersed therein for twelve hours, after which they are wrung out and dried. They may

require to be put back in the liquor for a few hours longer, depending upon their condition. The flesh side after drying may be cleaned and made smooth with sandpaper or pumice stone.

The ingredients of the paste may be made into a liquor and used warm, and the stock left therein for twenty-four hours. This method of tanning makes the skins very soft, the hair is finely set, and has a peculiar gloss that is especially desirable.

Oiling Alum-tanned Skins.—Alum-tanned skins that are not naturally greasy, such as calfskins, deerskins, etc., should receive a coat of oil after they have been tanned and dressed down. A good mineral oil is satisfactory. Mop the oil over the skins, let them lay in a pile for a few days and then hang them up to dry. Working out and cleaning in sawdust complete the process. The sawdust not only takes the dirt out of the hair but also absorbs the oil, so that when cleaned in an open wheel the skins are made soft and clean. Sometimes two or three runnings in sawdust are required to properly clean and finish them.

A solution of soap, also one of stearine, is recommended for alum-tanned skins. The use of either of these solutions fixes the tannage so that it cannot be easily removed by water and also makes the skins softer.

Dogskins can be tanned in any of the processes described for furs and hair skins, also with sulphate of alumina and salt as directed for wool skins. No oil or grease is necessary to make them soft. It is usually necessary, though, to degrease them, which is done with whiting and salt.

A practical method of tanning dogskins consists in immersing them, after wasling in sal soda water, in a solution of alum and salt or one of sulphate of alumina and salt for a few days, which accomplishes thorough tanning and setting of the hair.

They are then rinsed in water and drained, then tacked out while wet upon boards or stretched in frames and a paste of whiting is applied to the flesh side. The paste is made of whiting and water, and should be quite thick. It is spread evenly on the skins, which are now placed in a warm room and

dried. In drying, the whiting absorbs the grease. The paste should then be scraped off and another coat put on and dried. The operation is repeated two, three, and sometimes four times until the grease is entirely absorbed and the whiting dries white. When the skins are free from grease, scrape off the whiting and wash the flesh; then either apply a tanning paste to the skins or put them into a tanning liquor of alum and salt to retan them, after which dry and finish in the usual manner. The retannage can also be a mixture of pulverized alum and fine salt rubbed into the wet skin.

RECEIPT FOR DEODORIZING FURS AND SKINS.

The following solution is useful in removing odor from furs and hair skins: Into four gallons of water put eight pounds of tanner's soap, or any other good bar soap, chipped fine. Add seven pounds of sal soda. Heat until the soap and soda are dissolved, and while hot, add one and one-quarter ounces of borax, five-eighths of an ounce of sulphate of soda, and one ounce of oil of sassafras. Put the solution aside to cool and it is then ready for use. This liquor can be used on skunk skins, but they should not be rinsed out before tanning. After tanning and drying, work them in hot sawdust and the odor will have disappeared.

HOW TO CLEAN FURS.

Dark furs may be cleaned with bran or with cedar, mahogany or other hardwood sawdust, which has been heated in an oven. Beat the fur gently with a switch until free from dust, then lay the skins on a table with the fur side up and rub the hot sawdust or bran through the fur. Use plenty of sawdust and rub vigorously. After this beat the skin until the sawdust or bran is out of the fur.

White furs can be cleaned in the same manner except that white cornmeal is used instead of sawdust. The cornmeal should be heated. Soiled places may be cleaned by rubbing with cube magnesia. Allow the powder from the magnesia to

remain in the fur for a day, then brush and shake the skin thoroughly.

Professional cleaners clean fur garments, muffs, etc., by dipping into gasoline until clean, then drying and smoothing by the use of hard bread crust, passing same lightly with the grain of the fur.

THE TANNING OF HIDES FOR ROBES, COATS, ETC.

Hides intended to be tanned with the hair upon them, and used in the manufacture of coats and robes, should be soaked in fresh water before they are tanned, in order to rid them of dirt, blood and other undesirable substances adhering to them. They should be soaked long enough to become thoroughly softened, the length of time varying from twelve to twenty-four hours. Dry hides are much more difficult to soften than salted ones. Borax is useful in softening dry hides, also a strong solution of salt and water. When borax is used, from five to six pounds of it are dissolved in hot water and poured into the water to be used for soaking and vigorously stirred throughout the same, the quantity of borax mentioned being enough for one thousand gallons of water. The effectiveness of the borax soak is increased when its temperature is raised with steam to about 90 degrees Fahr. The hides may be left in the soak for twelve hours, and should then be worked upon the beam or milled in a drum in a solution of borax and water, or they may be softened in a hide mill. After the milling, they require further soaking in the vats, according to their condition. When a salt solution is used, it should be made up in a vat and sufficient salt should be taken to make the liquor decidedly salty. The hides may be left in the brine for from twelve to twenty-four hours, next milled in a pin-mill drum in the salt solution for thirty minutes, and then put back into the brine for another twelve or twenty-four hours. This method of softening is very satisfactory. After the soaking is completed, the hides should be fleshed, and all flesh and lumps of fat removed from them before they are tanned.

Sometimes hides are received by tanners in a partially tanned condition, that is, some one has attempted to tan them without sufficient knowledge or without the facilities necessary to do the work. In order to soften and cleanse such goods so that they can be readily tanned and finished, they should be placed in a pin-mill drum with either a borax solution or a solution of salt and water and milled in the same until sufficiently softened. They must be watched, however, to see that the hair does not become loosened by the violent treatment in the mill. There are various ways of tanning hides with the hair on. A very common method is by the use of alum and salt. This is really more of a curing than a tanning process. While the hides can be made very soft and strong by the use of alum and salt, they have one very objectionable feature. They gather moisture and become heavy and damp in moist weather.

ALUM AND SALT PROCESS.

In applying the alum and salt process, the hides are taken after being fleshed, and are immersed in a fairly strong solution of alum and salt, care being taken to expose all parts of the flesh side to the liquor, so that the hair roots may become firmly fixed and hair slipping avoided. The hides should be given plenty of room in the liquor, so that they can be handled about once in a while, and their positions changed. It is good practice to hang them upon sticks and suspend them in the liquor. The strength of the alum and salt solution is a matter of judgment. The stronger it is the more readily it will penetrate into the hides and the less will be the time consumed by the process. Perhaps as good a rule to follow as any is to use twice as much salt as alum. Hides may be well struck through with a liquor made up of six pounds of alum and twelve pounds of salt for each one hundred pounds of them to be tanned. They should be left in the liquor until they have become permeated with it, the length of time required to accomplish this depending upon their thickness and the strength of alum and salt liquor, after which they should be soaked for ten minutes

in clean cold water, drained and hung up to dry. When they have become about two-thirds dry they should be laid in piles for a few days to become uniformly soft and moist, before they are dressed down to the desired substance. While they are lying in piles they must be watched and occasionally handled, especially in warm weather, to prevent heating, which always causes more or less damage, according to the degree of heat developed.

The dressing or cutting down to a light substance is generally done by hand. This work requires considerable skill and judgment in order that the hide may be smooth and of even thickness and free from holes. After the hides have been cut or dressed down, it is advisable to retan them. This may be done in various ways. They may be placed back in the alum and salt solution; they may be retanned with alum and salt in a pin-mill drum; or sulphate of alumina and salt, followed by a treatment with hyposulphite of soda, may be used, and the retanning may also be done in pin-mill drums with a solution of gambier and salt, or a combination of quebracho and hemlock liquors. Quebracho extract, being a good tanner and making soft stock, may be used alone.

To retan the hides place them in a pin-mill drum with a solution of sulphate of alumina and salt, made up in the proportions of four pounds of the alumina and eight pounds of salt, dissolved, and mixed into twenty gallons of water for every one hundred pounds of hides. In this solution the hides may be drummed from thirty minutes to one hour. Then for every one hundred pounds of stock in the drum ten pounds of hyposulphite of soda may be dissolved in five gallons of warm water and added to the contents of the drum. A further drumming for thirty minutes completes the process, and secures a permanent fixation of the tanning materials upon the fibers of the hides. When taken from the drum the hides should be dipped singly into cold water to remove surplus tanning material, drained, hung up and dried. When they are nearly dry and yet retaining some moisture, they should be stuffed with oil or

grease and then dried thoroughly, after which they require thorough working to regain their softness lost during drying, and also a thorough cleaning in dry sawdust. By a retannage of gambier and salt, the unpleasant features of alum-tanned stock are prevented, and the hides made permanently soft and strong. The gambier and salt liquor may be applied either in drums or in vats, the process being carried along until the liquor has thoroughly permeated the hides; then they may be left in piles for forty-eight hours, drained well, and hung up to dry.

A combination liquor of quebracho and hemlock extracts produces good results. About two-thirds of the liquor should be quebracho and one-third hemlock; one supplements the other. A weak solution of quebracho extract may be used alone. These vegetable-tanning materials may be applied in drums or vats.

SOFTENING THE STOCK.

For the purpose of imparting softness to the stock, oils of various descriptions may be used, also combinations of tallow, soap and oil. Fish oils are very satisfactory, but somewhat too expensive. Mineral oils of good quality produce good results. A heavy coat of the oil should be given upon the flesh sides. Any excess of water in the hides should be guarded against, as this prevents the proper absorption of the oil. The oil should be allowed to penetrate into the goods by slow drying, after which they should be left in the dry condition for some time before they are finished. The longer the hides are kept in the dry condition, the softer they will be when they are finally finished.

Softening and cleaning of the hides is best accomplished in revolving mills or drums especially constructed for the purpose. The oil, grease and dirt are taken up by dry sawdust in a closed drum, and in an open drum the sawdust carrying the oil and grease with it, is cleaned out of the stock. The cleaning process needs to be repeated two or three times to get the stock perfectly clean and soft.

Calf-skins and other hair skins may be tanned in the manners suggested for heavy hides. In the case of alum-tanned stock, some yellow ochre may be added to the saw-dust, it gives to the flesh side a desirable yellow color.

SECTION TEN.

MISCELLANEOUS PROCESSES OF TANNING, COLORING, AND FINISHING LEATHER.

HOW TO MAKE AND USE ACID-FAT LIQUOR.

Acid Fat-liquor of Castor Oil.—In the manufacture of sulphonated oil for acid fat-liquor, the acid must be added very slowly to the oil; the oil should be very thoroughly stirred while the acid is being added to it and when it is being washed out; the oil must be kept chilled while it is being acidified.

Take a barrel and saw it in two parts just below the two hoops near the top. This makes a tub of suitable size. Then put a 15-gallon crock into the half barrel and surround it with cold water by filling the half barrel. If the water is not below 60 degrees Fahr., add ice to bring the temperature down, since it must be cold enough to chill the oil. Put six gallons of No. 2 castor oil into the crock and allow it to stand over night to become thoroughly chilled.

The next morning at eight o'clock stir very carefully and thoroughly into the oil six ounces of sulphuric acid of 66 degrees Baumé and stir for at least five minutes after the acid has been poured in. At eleven o'clock stir in six ounces more of sulphuric acid, taking care to add it slowly and to stir very thoroughly. At three o'clock in the afternoon stir in another six ounces of acid, and at six o'clock six ounces more should be added under careful and thorough stirring. The next morning at seven o'clock add six ounces of acid to the oil, and every three hours thereafter add six ounces of acid until twenty-four ounces have been stirred into the oil the second day.

On the morning of the third day, take a perfectly clean barrel and put a wooden spigot into it as close to the bottom

as possible. Put the barrel upon a box or block, so that it will be six or eight inches off the floor. Pour the acid-treated oil into the barrel and fill the latter two-thirds full of water at 85 degrees Fahr. Add to the water and oil thirty pounds of salt and stir for fifteen minutes. Do this every half hour for five hours; then allow the oil to rise to the top, open the spigot and let the salt water run off until oil begins to show. Close the spigot and fill the barrel with warm water as before, then add twenty-four pounds of salt and stir for fifteen minutes. Allow the oil and salt water to stand over night until the morning of the fourth day. Then draw the water off as before, and fill the barrel again with water, adding eighteen pounds of salt and stirring the same as before. Then draw off the water again and fill the barrel with warm water and put in fifteen pounds of salt. Stir thoroughly for ten or fifteen minutes and allow the oil to stand over night. The next morning draw the water off, and the oil that remains in the barrel is ready for use. In order to get a satisfactory product the oil must be well stirred when washing out the acid, and the acid must never be put in fast enough to burn the oil. To keep the oil, add a little water to it, about twice its own weight; before adding the water, stir in enough concentrated ammonia to neutralize whatever acid there may be in the oil and to carry the oil to the alkaline side.

Acid Fat-liquors of Neatsfoot and Cod Oils.—Take thirty pounds of neatsfoot oil and twenty pounds of cod oil and mix them in a twenty or twenty-five gallon crock, which should be standing in a tub containing cold water. If the temperature of the water is more than 65 degrees Fahr. add some ice to it so that it will be cold enough to chill the oil. Put the oil in the crock before closing down for the night, and in the morning it will be chilled. For the fifty pounds of oil use eighty-eight ounces of sulphuric acid and divide it into four equal portions. In the morning about eight o'clock pour one portion of the acid, 22 ounces, very slowly into the oil, stirring the oil while the acid is being added and for five minutes afterward. It

should take about fifteen minutes to add the acid. Allow the oil to stand until five o'clock in the afternoon. Then add another portion of the acid, stirring thoroughly as in the morning. Let the oil stand until the next morning, and then add to it very slowly and with thorough stirring 22 ounces more of acid. At about five o'clock of the second day, add the last portion of acid to the oil, stirring thoroughly as before, and taking fifteen minutes to add the acid. Thus the eighty-eight ounces of acid have been stirred into the oil.

On the morning of the third day, the acid-treated oil is in condition to be washed. Use a large barrel or tub that will hold one hundred gallons, and put a spigot in it as close to the bottom as possible, and put the barrel or tub on an elevation so that it will be some distance from the floor. Put the oil into the tub or barrel and add enough water at 100 degrees Fahr. to make the tub nearly half full of water. To the water add a pailful of Glauber's salt and stir hard, then add more water until nearly full. Allow this to stand until towards night of the third day, then open the spigot and let the water run off. Close the spigot and fill the tub same as before with warm water and add a little less than a pailful of Glauber's salt. Allow the mixture to stand until the next day and then draw off the water the same as before. Then fill up again with warm water and use one and one-quarter pailfuls of common salt. Stir the oil and the water very thoroughly, and allow the mixture to stand twelve hours. Then draw off the water and fill the tub again nearly full with warm water, and add one and one-half pailfuls of common salt. Stir the oil very thoroughly, and then allow the mixture to stand until the next day. The water should then be drawn off, and the oil is now ready for use.

In using neatsfoot and cod oils equal parts of the two oils may be employed. From one and one-half to two ounces of acid should be taken for every pound of oil, never more than the latter quantity. A little more than one and three-fourths ounces is a safe quantity for each pound of oil. The acid should be divided into four equal portions. When the washing

of the oil is completed add cold water, about twice the weight of the oil, and enough strong ammonia to neutralize the last traces of acid that remain in the oil.

Castor oil may be treated in the same manner as described for neatsfoot and cod oils. While these oils make good fat-liquor, castor oil really makes the more desirable article.

How to Use the Acid-Treated Oil.—When the oil has been properly treated with acid and washed it is readily soluble in warm water. To use it, the required quantity is dissolved in water and the skins are drummed in the solution. One hundred pounds of chrome leather may be fat-liquored with from four to five and one-half pounds of the oil dissolved in ten or twelve gallons of water at 125 degrees Fahr. The drum used for the purpose should be as clean as possible; and the skins should be warmed in the hot drum before they are given the fat-liquor. The exact quantity of oil to be used must be determined by the man in charge of the work, and depends upon the degree of softness desired. Drum the leather in the fat-liquor from thirty to forty minutes; then take it out and rinse it off, each piece singly, in a tub of clean hot water so as to remove the oil from the exterior. This operation is especially necessary when the skins are colored after fat-liquoring. If colored before fat-liquoring, rinse the leather, let it drain a few hours, then strike it out and dry it without oiling the grain.

HOW TO COLOR CHROME-TANNED SKINS WITH SUMAC AND ANILINE DYES.

A satisfactory way to color the skins consists of mordanting with sumac and tartar emetic and then applying the dye. For one dozen skins of average size two pounds of dry powdered sumac are used. The sumac is added to warm water at about 110 degrees Fahr., and the goods are drummed in the liquor twenty minutes. Then add for each dozen skins two ounces of tartar emetic, dissolved in hot water and drum twenty minutes longer. Then rinse in clean, warm water to free them from the sumac, put them back into the drum, which should be empty

and clean, and drum in the aniline solution. Extract of sumac is also used with good results. For six dozen skins of average size about one and one-half pounds of the extract are used in water at 110 degrees Fahr. Drum the skins in this liquor twenty minutes; then dissolve and pour into the drum three-quarters of a pound of tartar emetic and drum twenty minutes longer. Then rinse the skins in warm water and color them.

Another good method of preparing skins for aniline coloring is carried out in the following manner: The skins are washed and shaved and put into a hot bath of Sicily sumac and alum, which makes them of a light color, softens them and prepares them for the coloring bath. They are then rinsed in warm water and struck out to remove surplus sumac; they are now in condition to be colored. The sumac bath may be applied in a drum or in a vat and tartar emetic may be used as described above. If white flesh and colored grain are wanted, the skins may be colored with brushes on the grain only, or folded grain out, and dipped into the dye.

These instructions apply to stock that is to be colored with basic aniline dyes. Chrome-tanned skins are also colored with acid dyes and without the use of sumac. The dyes used upon skins treated with sumac are not suitable for dyeing leather not treated with it, whereas dyes that are used for this purpose may also be applied to sumaced skins, upon which, however, they produce somewhat different shades.

The dyeing is done preferably in a drum; and it is always best to start with about one-third of the quantity of dyestuff required and to add the rest after about ten minutes, the dyeing being then continued twenty minutes or longer or until the skins have absorbed the dyestuff and are colored the shade desired. After dyeing, the goods are rinsed in cold water, struck out and fat-liquored.

Instead of experimenting with different dyes, in the effort to get a certain shade, it is better for a tanner to send a piece of leather, colored the desired shade, to some good dye supply house and have the practical dyers there match it. Almost

any shade can be matched in this way. Very frequently it is necessary to combine two, three or more dyes in varying proportions in order to get the shade that is wanted. Nearly all the popular shades can be procured of the dealers in dyestuffs, requiring only careful application to get satisfactory results. The methods of preparing the skins that have been described are applicable to the coloring of any kind of them; they have been used in the production of marketable leather.

RETANNING WITH GAMBIER AND SUMAC.

Leather that has been tanned in hemlock liquors, no matter what the finish may be, is much improved by being retanned with gambier and sumac. Hemlock has excellent filling properties, but it also makes the leather somewhat harsh, and the black on such leather after a time turns to a dull gray black. When the leather is retanned with gambier and sumac, the flanks are made fuller and firmer, the fibers are slightly contracted, the harshness of the hemlock is toned down, and the leather is given a smooth feel and the color will not fade. The results are firmer, tougher and more supple leather, a more permanent and deeper black. The leather is tanned with hemlock and then split.

The retanning is preferably done in a drum, as it can thus be accomplished in less time than is required in a vat. A good retanning liquor for harness and other leathers is prepared in the following manner: Boil in eighty gallons of water two hundred and fifty pounds of gambier; when fairly cool, skim off all foreign matter. Ten gallons of this liquor are sufficient for thirty average sides, and this quantity is put into the drum together with the leather and to it are added two gallons of dry sumac and as much water as is needed to make the leather wet without dripping. Run the leather in the liquor at least thirty minutes. The sides should then be packed in boxes by doubling the flesh side outwards and left in that condition for ten or twelve hours. They should then be scoured or washed and treated in the usual way of coloring, fat-liquoring, etc.,

according to the kind of leather and the finish that is wanted. Thirty minutes in the drum will do as much for the leather as a much longer time in a vat. Gambier and sumac used as described greatly improve the leather, and the expense of their use is repaid by the improved quality. Palmetto extract may be used with good results in place of gambier and sumac, as well as oak extract.

Bark and extract-tanned leather may be retanned with gambier and sumac in the following manner: Two pailfuls of Sicily sumac fifteen minutes are boiled in forty gallons of water, and the resulting liquor is allowed to stand over night. The next morning twelve and one-half pounds of gambier are boiled until dissolved, and this solution and ten pounds of salt are added to the sumac liquor. There should be fifty gallons of the liquor, which should be used at 80 degrees Fahr. The leather is run in it for one hour, then left in piles twenty-four hours, next rinsed off, and fat-liquored. Before being retanned, the leather, after it has been split and shaved, should be washed one-half hour in warm water containing three pounds of salts of tartar dissolved in fifty gallons of water. It is next drained and washed for fifteen minutes, and then retanned.

Retanning with Sumac.—One dozen medium-sized sides may be retanned with two pailfuls of sumac. The sumac is boiled in twenty gallons of water, and the liquor allowed to stand until it is cool. The leather is then drummed in it from one to one-half hours, and next placed in a pile for twenty-four hours. It is then drummed in sumac again, the same as before, and then piled down for twenty-four hours, after which it is dipped into warm water, to wash off the sumac, scoured, fat-liquored and dried.

TANNING WITH GAMBIER, SUMAC AND OAK EXTRACT.

This process of tanning may be used in tanning sheep, calf and goat skins for linings and for other colored and black leather. The skins should not be pickled after drenching; if they are pickled it is advisable to remove the pickle before

tanning them. A liquor composed of gambier and sumac of about 10 degrees barkometer is prepared in a paddle vat. After the skins have been in this liquor five hours, they are put into a gambier liquor of about 20 degrees barkometer. It is advisable to add a quart of acetic acid to every five or six dozen of them. They remain in this liquor seven hours.

The third liquor should be made up to a strength of 30 or 35 degrees barkometer, and the same quantity of acid should be added to it. After the skins have been in this liquor half an hour a pailful of oak wood extract should be dissolved and added. When thoroughly tanned, the skins are horsed up and drained, then sumaced. A sumac liquor is made up in a paddle vat by using twenty-five pounds of best Sicily sumac in water heated to 125 degrees Fahr., the liquor being cooled down to 90 degrees Fahr. before the skins are put in. They may be turned in this liquor several hours, or an hour or two, and left in over night. They are then drained, rinsed off, and hung up to dry, or fat-liquored and dried.

When thoroughly dry, they may be dampened, shaved and colored any desired shade or dyed black. The leather is soft and well tanned.

Undoubtedly equally good results would be obtained by using quebracho or palmetto extract in place of gambier.

PROCESS OF COLORING CHROME LEATHER AFTER FAT-LIQUORING.

Mr. Charles Lamb, an English leather expert, describes in the following words a process of coloring chrome-tanned leather that he perfected :

“Considerable difficulty has been experienced in the dyeing of chrome leather, especially if the dyeing is done after the operation known as fat-liquoring, which consists in treating the leather with a mixture of soap and oil.

“Chrome-tanned leather takes the dye exceedingly well before it has been fat-liquored, but this method of working has the very serious objection that the subsequent fat-liquoring

takes a part of the dye out of the skins, thus making it practically impossible to dye to shade. The main objection to dyeing after fat-liquoring is the great amount of dye that must be used in order to produce a full shade. Another objection is that sulphuric acid cannot be employed with the acid colors, as is done in dyeing ordinary vegetable-tanned stock. The action of the sulphuric acid in the latter case is to liberate the color acid of the dyestuff, which combines with the fiber of the leather, and so produces a depth of color on the skin fully twice as deep as would have been the case had no vitriol been there. If vitriol was added to the dye bath in which a fat-liquored chrome-tanned skin was being dyed, the vitriol would decompose the soap with which the skin had been fat-liquored, separating the fatty acids of the soap, which, being of a greasy nature, would prevent the dye working on, patchy dyeing being the result. The greasiness would also seriously interfere with the finishing process. After several months' research with a view to find some material that would take the place of sulphuric acid and yet not have any action on the fat-liquor, I found that if chrome leather was dyed with the acid colors in a bath to which a small quantity of sodium or potassium bisulphate had been added, it was quite practicable to produce shades twice as full as when no such addition of sodium or potassium bisulphate had been made.

"When the skins have been thoroughly soaked back in warm water, after fat-liquoring and drying out, they are ready for dyeing, this being best effected in a drum fitted with steam pipes; neither the paddle nor the tray are suitable without some appliance for keeping the dye bath hot. The dyeing is best carried out at a temperature of 140 degrees Fahr.

"The manipulation is as follows: The dye is carefully weighed out into a small wooden tub, and dissolved by pouring upon it about 200 times its weight of boiling water, stirring briskly all the time until the dye has entirely gone into solution; and now bisulphate of soda, equal in weight to the weight of the dyestuff, is dissolved in a sufficient quantity of

hot water in a separate vessel. Half of the concentrated solution is now added, together with the bisulphate of soda solution, to a sufficient quantity of water at 140 degrees Fahr. in the drum to cover the skins; the goods are entered and the drum is started. After running the goods in this dye bath for fifteen minutes, the remainder of the dye solution is added, and the running continued for at least thirty minutes longer, or until the goods have attained the depth of shade required. The quantities of dyestuff and bisulphate of soda necessary for each dozen skins would be eight to ten ounces of the former, according to the desired depth of shade, and, as stated, an equal quantity of the latter. After dyeing, the skins are washed in warm water, set out, lightly rubbed over the grain with glycerine, and dried out strained on boards."

DEGREASING SKINS AND LEATHER.

In the coloring and finishing of some kinds of leather, considerable trouble is encountered by the dyer and finisher in trying to get clear and uniform colors and a clear, bright finish, owing to the grease in the leather. Sheepskins especially are full of natural grease that is difficult to get rid of. In some instances, too, the leather, although not naturally greasy, contains so much oil and fat-liquor that satisfactory coloring and finishing are almost impossible. Chrome-tanned leather intended for a patent or enameled finish must be free from grease before the finish can be put on.

Much of the natural grease in sheepskins can be removed by pressing previous to tanning, in a hydraulic press, after they have been limed and also while they are in a pickled condition. The pressure applied is very great, and large quantities of grease are removed in this way. Pressing before tanning is always advisable, and yet this method is not always as effectual as might be desired. Treatment with naphtha in liquid or gaseous form is often resorted to. Other methods are sometimes used, but while they remove the grease they also injure the skins.

To remove the animal grease from pickled sheepskins they should be wrung or pressed, then drummed in salt water and then treated in a bath of whiting and salt, which removes some grease and the acid used in pickling. Use five pounds of salt and two pounds of bolted whiting in water at 90 degrees Fahr. for one hundred pounds of stock. Drum the skins in this liquor one-half hour, let them stand one-half hour, then wash them in two baths of clean, warm salt water to remove all the whiting. Salt must always be used in washing to keep the skins from swelling.

If a paddle-vat is employed, use ten pounds of whiting, one pound of common salt and one pound of sal soda for each four hundred gallons of warm water in the vat. After the skins are in, run the paddle thirty minutes, then let them remain in the bath one hour, run the paddle again for fifteen minutes, then wash them in two saltwater baths before tanning them. While this treatment is effective it should not be used on skins intended to be tanned with tanolin or other one-bath material. For such stock use a drench of sour bran and salt. It not infrequently happens that after leather is finished the oil and grease in it come out upon the surface in the form of white grease spots that spoil the appearance and injure the finish. And when impure or low-grade oil is used quantities of gummy or resinous matter are deposited in the skins, and these have a detrimental effect upon the quality of the leather. Leather must be free from uncombined oil and grease, and have a clean, dry grain before a bright finish can be obtained. Treating greasy leather with lactic acid by drumming in a dilute solution of it before coloring it, and then applying a solution of the acid to the grain before putting on any seasoning, help in overcoming greasy grain and in getting a clear and bright finish. Then there is the method of treating leather with naphtha by which every particle of oil and fat is removed. It is used after the skins have been dried and before they are finished. For degreasing tanned sheep and goat skins and patent leather naphtha is the only satisfactory process. The work should be done in a

building apart from the main factory, and no fire or light should be allowed near the naphtha vats.

The skins are immersed in a bath of naphtha, preferably the ordinary commercial article, in a tank or closed vessel or drum which either revolves or in which they can be stirred or otherwise agitated so as to insure rapid and thorough permeation of the naphtha. By processing the greasy leather in the naphtha the liquid becomes so thoroughly saturated with the oily matter extracted that it will take up no more. If one bath is not sufficient to extract all the grease, the skins are removed to another and cleaner bath and drenched therein as in the first bath. They may be subjected to a fresh supply of naphtha again and again until the liquid in which they are last placed remains pure, and so far unaffected thereby as not to show the least trace of oil or grease.

The action of the naphtha is quite harmless, and, if the leather was fat-liquored and oiled well, no strength will be lost through the treatment. A naphtha plant can be operated economically, but if its use is not practicable the leather can be degreased by soaking it in the fluid for several hours and then pressing out the naphtha with a slicker. On a small scale the work can be done by throwing the skins loosely and separately into the naphtha in a tank or vessel of sufficient size, and stirring them about for an hour or two, the time depending on their thickness and condition. Light skins show a difference after they have been in the liquid a half hour. When they seem sufficiently degreased they should be taken from the naphtha, pressed out with a slicker, and then hung up until the naphtha is entirely evaporated.

When an unsuitable oil has been used upon the skins, it is sometimes necessary to purify them from the gummy matters that have resisted the action of the naphtha. In such cases a drenching with alcohol, wood-spirit, ammonia or some other solvent is required. After this treatment the leather is dried and finished in the usual way, and when it is glazed it is unusually bright and clear, and the fibers are tough, soft and strong.

The Leather Trades Review says: "Leather is degreased by treatment with volatile solvents, which have the power of dissolving the contained grease. The common method of degreasing is to hang the goods in a closed chamber, into which the vapor of light petroleum ether or benzine is allowed to enter, the benzine or petroleum ether completely dissolving the grease. The solvent condenses on the leather, and a liquid then exudes which flows to the bottom of the chamber and is run away into a distilling plant placed in close proximity, by which the solvent is recovered, to again, in the form of vapor, pass into the chamber. In this way the goods are subjected to a continuous current of the solvent, and they are allowed to hang in the chamber until every particle of grease has been extracted.

"Another form of degreasing plant is one in which the goods are suspended in a liquid solvent in a closed chamber, closed in order to preclude evaporation, the goods being allowed to remain in the solution until degreased, grease and solvent being afterwards separated by distillation. In Australia and New Zealand it is a common practice to simply suspend the goods in an open vat containing benzine until degreased, the resulting liquid mixture of grease and benzine being used over and over again until so greasy that it will no longer degrease; it is then run away and the vat supplied with fresh solvent. This last method is most wasteful, for it means the loss of both solvent and grease."

THE DEGREASING OF SHEEPSKIN.

In tanneries, writes W. Eitner in "Der Gerber," the grease of sheepskins is often extracted by pressing the skins out of warm water; in American works it is extracted mainly by hydraulic pressure, and the skins are often used for colored leather afterward. Sheepskin fat is soluble in hot alcohol, ether, chloroform, petroleum ether, commercial benzoline and naphtha; all of these mediums are used for degreasing mostly tanned leather, for which purpose a proper apparatus is necessary.

Both mechanical and extractive methods are in use at several works, the former being the more popular as being the cheaper plan. This method has the disadvantage of only partially degreasing the skins, it being impossible to do so completely by pressing, although if the proportion of fat is not very great the object is sufficiently accomplished.

Complete degreasing can be effected by extraction, but requires plenty of material and an expensive plant. In more recent times both methods are combined in Argentina. In Buenos Ayres, where 20,000 sheep are slaughtered daily for export in frozen condition, a French company takes the skins in hand. They are dewooled by sweating, and the pelts go partly to local tanneries and are partly air-dried and exported to North America. The Argentine sheep belong to the fine woolled class and are very fat, some specimens possessing up to as much as 30 per cent. per pelt. They have therefore to be degreased, and owing to this high proportion of fat the process has to be effected partly in the pelt, as the subsequent tanning would be very difficult.

The method of degreasing followed out in Buenos Ayres is as follows: The pelts, dewooled by sweating, are put into the degreasing apparatus, which consists of a metal drum coated with zinc, and which can be hermetically closed. To the pelts, which are still in a wet condition, the degreasing liquor is added. This consists of benzoline and methyl alcohol. The latter is used because the pelts are wet, and the benzoline, which does not mix with water, would not penetrate the skin and neutralize the grease. The alcohol is the medium to assist in mixing the water and benzoline, and ensures the desired effect on the wet pelt.

After the pelts have been in the drum for an hour or an hour and a half, they are taken out and pressed quickly; by this process most of the grease comes away in liquid form. The mass pressed out can by distillation be reworked, and the degreasing materials recovered with a loss of about thirty per cent. The skins are then soaked in water and thrown into the lime

pits and worked in the usual manner, the resulting leather being of good quality and free from grease. For ordinary purposes the above method could be modified as follows: The dewooled skins, after soaking and liming, may be reduced in the paddle vat by lukewarm water and thoroughly stretched on the Vaughn machine, and after this put into the extraction apparatus. This operation is succeeded by pressing and a treatment in a drench or bate. If the skins are not too greasy a second putting through the machine would be an improvement.

After tanned skins have been degreased, it is generally necessary to retan them, as the tannage of greasy skins comes out easily. In the backs and necks of sheepskins, hollow places are often found which have been full of fat but after degreasing form a very wrinkled grain.

Formerly sheepskin-fat was thought to be much the same as other animal grease, and that it was composed of fatty acids and glycerine; but this supposition is incorrect, as it is a cholesterolin fat, and as regards composition, possesses many of the characteristics of wool-grease, the latter being semi-fluid while that extracted from tanned skins is liquid, and forms no emulsion with water, a fact which prevents any emulsifying methods from being used in degreasing. Sheepskin-fat forms no lime soap in the lime pits, which is very favorable for tanning, as it could not be got out even by prolonged mechanical work, and it would in consequence be very bad for tanners of sheep and lamb skins, as every skin contains this grease. Some sorts, of course, contain much more than others, and as much as forty per cent. of the gross weight may be found in some classes. The fact of the fat being in a liquid form favors mechanical degreasing of sheepskins and, in this state yields more readily to this treatment than a more solid fat.

Retanning Degreased Sheepskins.—Very greasy skins absorb the tanning material only with difficulty and incompletely. The most greasy portions remain almost untanned. After the grease is removed such portions of the skins are hard and other portions that were well tanned are loose and spongy. For these

reasons skins that have been degreased after tanning must be retanned and a rich tannage is necessary. This applies to vegetable-tanned stock. The best material for retanning is one that will tan mildly without making the leather loose and spongy and at the same time give a nice light color. Sumac is undoubtedly the most suitable material for the purpose. The retanning is best accomplished in a drum, as in this manner the greatest amount of tannin is absorbed. The liquor may be made 2 to 3 degrees Baumé, strong, and the skins should be run in the drum two or three hours according to their weight, then dried and finished.

PIGSKIN LEATHER.

Pigskins have from time immemorial been used for many purposes; at the present time they are more extensively employed than ever. When properly tanned they are as durable as goatskins, as pliable as calfskins, and present a peculiarly attractive appearance. They are finished in russet and colors and are used for innersoling, saddles, traveling bags, pocket-books, belts, jewelry cases, bindings of books, sporting goods, shoes, slippers, suspenders, leggings, military equipments, trusses, wall decorations, screens, and for upholstering, carriage and automobile trimmings.

Sheepskins and cowhides are embossed so as to resemble pigskin in appearance; but no imitation possesses the peculiar qualities of the genuine article. Public interest in pig leather has steadily increased and it is now very popular. A few practical ways to tan pigskins will here be described.

Washing and Degreasing.—Pigskins contain a great deal of grease that should be gotten rid of before they are limed, or the leather will be greasy and hard. After they have been scraped out dry before soaking, they are washed in a warm solution of sal soda. Put about five pounds of sal soda into a barrel of water heated to 95 degrees Fahr. Put the skins, one at a time, into this water, leave therein long enough to get soaked through and then put them on the beam and strike them out thoroughly

with a dull knife, bearing on hard and forcing out as much of the grease as possible. This may be done two or three times; the skins are then rinsed off in the warm water and soaked for some hours in cold water before unhairing and liming. A great deal of grease can be forced out of them by passing them through sal soda solution and then working them out over a beam. They are next soaked and fleshed and are then in condition to be unhaired.

Unhairing.—Run seven hundred gallons of water into a paddle vat, and add to it one hundred pounds of patented depilatory crystals previously dissolved in hot water. Put a pack of skins into this liquor and leave them therein until the hair is dissolved, when they are ready to be limed. Sulphide of sodium may be used in this process either in a vat or in a drum. One pound should be used for every seven gallons of water. The solution dissolves the hair and swells the skins. The next process is liming.

Liming.—Slake one hundred pounds of lime and add the solution to seven hundred gallons of water. Put the unhaired skins into this liquor and turn them in it for two days or longer according to their thickness and condition. Then wash them and scrape the flesh side again. Some of the hairs that may be broken on the grain should be removed from the flesh and at the same time much of the remaining grease will come out. The skins are then in condition to be bated.

Bating.—Prepare a paddle vat with water warmed to 120 degrees Fahr. Put into the water two pailfuls of dry bran and allow to stand over night. In the morning bring the temperature up to 95 degrees Fahr., and add one pint of lactic acid to the bran liquor. Throw a suitable number of skins into the liquor and then add another pint of lactic acid. Run the paddle from three to five hours, then take the skins out and wash them well. They should be thoroughly worked out of the bate or drench and all lime and dissolved grease should be forced out. Work them over a beam with a union worker and they are then ready for the scudding table. Use a hand-glass and set with

dull, smooth edges as the grain is easily damaged. After working out the grain, the skins should be rinsed in warm water and then put into the tan liquor.

Tanning.—Quebracho extract makes a good tannage. Prepare a liquor by adding enough dissolved extract to seven hundred gallons of water in a paddle to make a four degrees barkometer liquor. To this liquor add ten pounds of alum and twenty-five pounds of salt dissolved in hot water. Plunge the liquor until it is thoroughly mixed. Start the wheel, throw in the skins and turn them for thirty-six hours or longer, which strikes them a light oak color and they may then be placed in the second bath. This should consist of clear quebracho liquor. Add enough dissolved extract to the water in the paddle vat to make a six degree barkometer liquor, leaving out alum and salt. Turn the skins thirty-six hours, then strengthen the liquor to ten degrees barkometer and leave them in the liquor for two days which completes the tanning.

A mixture of quebracho and hemlock extracts may be used; also a mixture of hemlock and oak extracts.

When the skins are tanned, pass them into a sumac liquor, oil them with neatsfoot oil on the grain and hang them up to dry or tack them on frames. After staking and boarding, they are ready for any finish. They can be bleached if lighter color is wanted, or colored any shade, or black. Quebracho tan makes a fine, natural grain, free from spew, and firm, strong leather. For bag leather hemlock extract is a good tannage, also hemlock and quebracho. The skins are started in a weak liquor which is strengthened twice a day until they are struck through, which takes about eight days. After tanning, they may be bleached like skirting leather and then drummed in a sumac bath. Next wash them with clean water, slick them out, give them a little oil and hang them up to dry. After drying, dampen and shave those that need to be shaved and then apply a coat of fat-liquor. Make the fat-liquor of soap; oil and degreas in the same manner as for calfskins, giving the leather about half as much fat-liquor as calfskins. Dry the

leather and store it away for a while to mellow. Then, if it is to be colored, dampen it and clean the grain with borax and sulphuric acid. To do this, wash the leather in a drum in a warm solution of borax for fifteen minutes. Drain the solution out of the drum and run the skins in a solution of sulphuric acid, made by adding enough acid to water to make a solution sharp enough to bite the tongue. Drum them in this solution, then wash them and run them in sumac again. After being rinsed they are in condition to be colored. When they are colored, give them a light coat of cod oil and dry them. Staking, boarding and glazing complete the process. Pigskins for bag leather should be quite firm and solid. If the grain is greasy a drumming in a lactic acid solution or in borax or soda previous to coloring clears the grain so that even coloring becomes more possible.

Pigskins are much used in plain russet finish. For this they need to be bleached according to the instructions given for bleaching russet leather.

Hemlock and quebracho extracts have been found a very satisfactory combination for tanning pigskins, resulting in tough, firm yet pliable leather that needs little or no bleaching and that can be easily colored.

For innersoling the skins are oiled with a combination of fish and mineral oils and finished by rolling under the rolling machine.

Tanning with Sumac, Oak Bark and Alum.—A soft, light-colored pigskin can be secured by tanning in the following manner:

Pickle the skins with sulphuric acid and salt to bleach them, next remove the acid in a drench of whiting and salt and then wash them in two baths of warm salt water. To make the tan liquor dissolve in six gallons of water, six pounds of alum, three pounds of Glauber's salt, four pounds of common salt. In another tub boil in five gallons of water, five pounds of ground sumac, three pounds of oak bark and one pound of ground nut-galls. Mix the two solutions, then strain while the mixture is hot, and add to it four ounces of sulphuric acid.

The liquor should be used lukewarm; and the skins should be drummed in it two or three hours, then allowed to drain twenty-four hours. Tanning can also be done in a paddle vat.

After draining, the skins should be struck out on both sides and oiled quite heavily with neatsfoot oil, and dried. As they dry they should be worked and staked so that when dry the leather is soft and pliable. They can be then colored any shade or left in the natural color of the tan. The leather is quite waterproof and durable.

Oak bark is an especially good tannage for pigskins; chestnut oak extract also.

Treatment with Sumac after Tanning.—Pigskins are improved by a bath of sumac after being tanned with quebracho or other tannage. A paddle vat is used. The liquor is prepared by adding to water at 125 degrees Fahr. twenty-five pounds of best Sicily sumac, cooling the liquor down to 90 degrees Fahr. before putting the skins in. The latter may be turned in the liquor several hours, or two or three hours, and then left in over night, then drained, oiled and dried.

White Pigskins.—For some purposes white pigskins are used. Thorough work in the beamhouse is the basis of such leather. Not only must the skins be soaked in sal soda water and worked over the beam to get rid of as much grease as possible, but they should also be quite heavily limed and bated, and then worked out again so as to be as clean as possible before the process of tanning is begun. If they are not too full of holes pickling and tanning can be done most advantageously in a drum. To pickle one hundred pounds of them use one pound of sulphuric acid, fifteen pounds of salt and fifteen gallons of water. Run them in this liquor one hour, then place them over a horse to drain at least twelve hours before tanning them.

Prepare the tan liquor by boiling twelve pounds of sulphate of alumina in ten gallons of water. In a pail dissolve by boiling in one gallon of water one and one-half pounds of bicarbonate of soda. Pour the soda solution slowly and with constant

stirring into the alumina solution. Care must be taken to pour the soda solution in slowly, for if it is added too fast the tan will be spoiled. The mixture should be cold when it is used.

Tanning is done as follows: Put the pickled skins into a drum together with ten gallons of water in which one pound of Glauber's salt and three pounds of common salt have been dissolved, these quantities being used for one hundred pounds of skins. Run them in this solution twenty minutes, then stop the drum and drain off the liquor. Then put the plug back and throw ten gallons of water at 75 degrees Fahr., and four pounds of salt into the drum, which should then be started and run fifteen minutes.

At the end of the fifteen minutes pour one-half of the alumina and soda solution into the drum and drum three hours. Then put the skins over a horse until the next day and then hang them up to dry. When dry, put them back into the drum together with eight gallons of water and drum ten minutes. Then add the other half of the alumina and soda liquor and run the skins in it for three hours. After they have drained twenty-four hours, hang them up to dry. It is advisable to keep them in the dry condition some time before finishing them.

When it is desired to fat-liquor and finish them, soften them with warm water and put them into the drum together with a solution of acid fat-liquor or sulphonated castor oil, and run them in it forty minutes. Seven or eight pounds of the soluble oil should be dissolved in eight gallons of water at 95 degrees Fahr. for one hundred pounds of dry skins. After the latter have absorbed the fat-liquor let them drain over night; then strike them out and apply a coat of glycerine and water into which French chalk has been stirred. Give the grain a liberal coat of this dressing and then hang the skins up to dry.

Dampening, staking and tacking on boards complete the process and make the skins ready for use.

If they are not fully tanned they can be dampened and re-tanned with alumina and soda; and if they are not sufficiently soft they can be given more fat-liquor. Nice white leather re-

sults from the use of this process, provided the beamhouse work is done as it should be.

TREATMENT OF DRY HIDES AND SKINS.

No other class of hides and skins with which tanners have to deal requires more thorough treatment in the preliminary process than those that are received in dry condition. Having been dried in the raw state, they are dry and hard; and before they can be worked through any process they must be brought back to the natural condition of softness, and cleansed from dirt, blood and salt. As they are almost waterproof and very thick and hard, they are softened with considerable difficulty. Before they become thoroughly dry, putrefaction often sets in, which, although it may not be noticed in the dry hide, will become apparent during the soaking process. Then every spot that was not perfectly cured, or that was tainted before drying will appear either by the hair coming off, the grain peeling, or by portions of the hide rotting away. Even when the hides are received in good condition, the thinner portions may decompose in the water before the thicker portions become thoroughly softened. Owing to the difficulties encountered in soaking dry hides, some tanners neglect them, although when received in good condition and treated properly they make nice leather.

To place the hides in clean water, with nothing to hasten the soaking, results in injury to the stock, since the thin portions along the sides and in the flanks become damaged before the thick portions are softened. Prolonged soaking is a waste of time and causes the loss of gelatine, which results in loose leather. The grain is very apt to be injured by what is known as *pitted* grain which spoils the hides for grain-finished leather. In order, therefore, to hasten the process and to bring the hides through in good shape, it is necessary to add to the water some solution that will assist in accomplishing these results. Borax, Wyandotte soda and sulphide of sodium are the best materials for this purpose. When borax is used, five pounds of it, dissolved in hot water, are enough for one thousand gallons of

water. The solution should be poured into the soak water and thoroughly plunged before the hides are put in. Wyandotte soda is also good to help the soaking of both green and dry hides.

Sulphide of sodium is undoubtedly the best softener. Five pounds of it will prepare one thousand gallons of water although more or less may be used as the water and hides seem to require. If the water is hard twelve ounces of it may be used for each one hundred gallons of water. Soak dry hides in the prepared water twenty-four hours, then take them out and run them in a dry mill one-half hour, after which let them lie in a pile from twelve to twenty-four hours. Then put them back in the same water they were taken out of, and soak them twenty-four hours longer; next haul them out and mill them again one-half hour, then flesh them. After fleshing, put them into clean cold water for twelve hours; then put them into lime or sulphide of sodium liquor.

The milling serves to shake the hides up and to soften the spots that resist the penetration of the water. Twenty-five pounds of sulphide of sodium may be used to each hundred heavy dry hides. Hides cured with arsenic should be worked through arsenic limes; those dried in the sun should be treated with a sulphide of sodium process to get the best results.

Decay of hides can be prevented by using the articles mentioned and by keeping the soak vats clean by frequently changing the water. Soaks in which previous packs containing refuse have been softened, soften dry hides in a short time, but the putrefactive element is stronger in such soaks than in new ones; and the latter are therefore the safest, and the least liable to cause injury to the grain.

The hides should not be crowded in the soaks but given plenty of room. It is good practice to hang them in the water. No exact rule can be given as to the length of time necessary to soften them as some soften more readily than others, and the temperature and condition of the water are determining factors. Soaking is assisted by warming the water to from 80 to 85 degrees Fahr. before putting the hides into it.

A good method to follow is to soak dry-salted hides until they are about half as soft as they should be; then to remove them, split them from head to tail, put them into an ordinary drum together with water and run them in it for thirty minutes. They may then be soaked for another day or two and drummed again if they seem to require it. Care must be taken that they are not milled until they are soft enough as the bending and pounding may injure them. Dry-salted hides require to be not only softened but also to have the salt that is dried in them dissolved and washed out. After the second milling, let them soak in clean, cold water from twelve to twenty-four hours before putting them into lime.

Dry hides are most satisfactorily prepared for tanning with sulphide of sodium unless they are intended for lace leather, when they should be unhaired with lime and arsenic, which make flatter leather than lime and sulphide of sodium.

The office of any material that is used to remove the hair is to swell and distend the fibers, thus loosening the hair roots and enabling the tanner to remove the hair, then to dissolve the perishable matter so that it can be removed before the hides are tanned. Sulphide of sodium, when used upon dry hides in conjunction with lime, loosens and splits off the fibers and freshens up the grain more efficiently than lime alone does. A satisfactory process is carried out in the following manner: Boil a quantity of sulphide of sodium, say two hundred pounds, in a barrel or tub. Let the solution get cold and then use only the clear liquor and discard the sediment. Add enough of the dissolved sulphide to water in a vat to make a six degree barkometer liquor. Put the hides in and allow them to remain twenty-four hours, then haul them out. Plunge the liquor up and put the hides back and keep them in twenty-four hours and then haul them out. After plunging the liquor again, put the hides back and keep them in the liquor twenty-four hours longer. Take them out, put them into a wash-mill with running water and wash them for thirty minutes to wash off the hair, and then put them into lime liquor. Slake two pecks of lime for each

hundred sides and put it into water in a suitable vat. Allow the sides to remain in this liquor two or three days, handling them two or three times during this time. They are then ready to be washed in cold water for fifteen minutes and can then be either split, or bated whole and split out of pickle. Dry hides come through this process full and plump and with a fine, strong grain.

Skins for some kinds of leather can also be treated in this same manner. Bating should be done with sour sugar and lactic acid or with a manure bate in order to get a soft, smooth grain. Dry skins, because of their thinness, are more easily softened than hides. Upon light skins, such as goat, calf and kangaroo, lime and arsenic produce the best results. But upon hair skcepskins sulphide of sodium is used as it makes them tougher and plumper than lime. Dry woolskins also are most suitably prepared with sulphide of sodium. The process is along these lines: After the skins are soaked, they are fleshed and then painted with a solution of sulphide or depilatory crystals. After having been painted, they are folded from neck to butt, hair or wool side out, and placed in piles until the next day when the hair or wool can be easily rubbed off. After this has been done, they are placed in a drum with a weak solution of sulphide of sodium and drummed in it for two hours. They are left in the liquor over night; and the next morning are washed in warm water to rid them of the hair now reduced to a slimy mass. They are then trimmed and fleshed and washed in a weak solution of bicarbonate of soda to rid them of the sulphide. When thoroughly washed, they are ready for the bate. Instead of using a clear solution of sulphide of sodium, a mixture of lime and sulphide may be used, or the skins may be placed in a weak lime liquor for two days after being washed from the sulphide. The use of lime in addition to sulphide of sodium makes soft leather that remains soft after it is finished, while leather upon which no lime is used has a tendency to become somewhat hard after it is finished awhile. No matter how dry and withered the skins may be,

this treatment brings them out as soft and fresh as green stock. Twenty-five pounds of sulphide is a sufficient quantity for twenty dozen skins. It should be dissolved by boiling in a barrel; the sediment is thrown away and the clear solution reduced in strength and increased in quantity by the addition of forty or fifty gallons of water. The process can also be carried out in a paddle vat, the skins being left in the liquor two or three days. The strength of the sulphide liquor in a paddle vat should be much less than in a drum, say one or one and a half degrees Baumé scale. Three pounds of bicarbonate of soda dissolved in twelve gallons of lukewarm water for one hundred pounds of skins washes out the sulphide more effectively than clear water.

Goatskins for firm leather may be prepared for tanning in this way, but for soft leather, such as shoe and glove stock, lime and arsenic followed by manure bating is the preferred process.

Dry hides for sole leather should be thoroughly soaked and then unhaired as promptly as possible and in such a manner as not to remove substance nor affect the weight of the leather. The most progressive tanners use fairly strong limes and reel the hides from one lime to another, taking care to plunge the lime before putting them in. Sulphide of sodium may be mixed with the lime and the hair loosened in a few days, which results in the tanner getting good, heavy and solid leather. After the hides are limed two or three days, they should be put into water for several hours, then passed along into the next process. The essential qualities of sole leather are weight and solidity. These are secured by short quick liming and unhairing.

When removed from the warm water, the hides are worked over the beam and again put into clean water to further cleanse them from the lime and dirt. The grain is made bright and clean by this treatment.

The results obtained on dry hides for heavy leather from the use of sulphide of sodium are greater weight, finer grain, ex-

ceeding toughness and strength, and less labor and anxiety. When no value is placed upon the hair, the hides can be painted upon the hair side with a solution of sulphide of sodium or with a mixture of sulphide and lime. They are then folded up separately with the hair on the inside and left until the hair can be easily removed, after which they may be washed and unhaired, and then limed for a day or two.

All dry hides that are to be split after unhairing can be made plump and the fibers swollen in a weak solution of sulphide of sodium, from one to three ounces being used for each hide, according to size; and a small quantity of lime may be added. A hard, firm body and fine grain result, but where softness is essential it is necessary to use more lime, and to lime the hides a little longer. Unless they are thoroughly washed to neutralize the sulphide, spots are apt to appear on the grain when they are put into vegetable tanning liquors. Iron in the sulphide also causes dark green spots on the grain. A solution of sulphide should not be used until it has stood several hours and become clarified by the sediment settling to the bottom of the vessel. The clear liquor only should be used. The sediment containing the iron, which causes the spots, should be thrown away.

Dry hides should always be pickled with sulphuric acid and salt after bating and before tanning.

TITANIUM MORDANTS ON CHROME AND VEGETABLE TANNED LEATHERS.

The utilization of the so-called "rare metals" for industrial purposes has made great advances during the last few years. Vanadium, selenium, tungsten, titanium, etc., are common in the manufacture of special classes of steels, tungsten in incandescent electric lamps, certain still rarer metallic oxides in the gas mantles; chromium is used in tanning in enormously increasing quantities.

Compounds of antimony are very useful as mordants and are used extensively. Some of these and other little used metals

are found on investigation to possess properties which are of the greatest assistance in industrial processes, and one of the most noteworthy is titanium.

This metal is widely distributed over the earth's surface. In nature, however, it never occurs as metal, but as the oxide TiO_2 , or combined with other compounds, notably iron oxide. It is very difficult to remove the impurities, which in a measure accounts for its being classed as a rare metal, and it is even more difficult to convert it into its salts so as to render it available for use in industrial processes. The salts are, however, now made on a commercial scale in this country and are being made use of to a considerable extent. The trade of dyeing and staining leather has begun to appreciate the help of this new element in the assistance its salts give in many processes of coloring and in mordanting colors and blacks.

As has previously been said, titanium is extremely difficult to reduce from its ores. Its name implies that it is a very Titan in holding to its ore form. It cannot be reduced, as the chemists say, by any ordinary means as the other metals. But when by heroic chemical methods it is reduced from its ores and converted into titanium salts, and when organic fibers, such as leather, and organic substances such as tannin and organic coloring matters, are treated with solutions of these titanium salts, the above-mentioned characteristic of holding on manifests itself. It combines with the fiber and with the tannin as well as with the coloring matter with the same titanic grip. And this grip is also rapid as will be shown. The results are extremely fast and stable colors, fast to light, washing, soaping, rubbing, etc. For the leather dyer the salt most suitable to use is the double salt, titanium-potassium oxalate, which is put on the market in the form of fine white crystals easily soluble in water. These crystals do not alter on keeping and are pure salts, *i. e.*, they contain no impurities of any kind, not a trace of iron or other foreign substances. They dissolve in water to a clear, colorless solution. Being a pure chemical salt there are no second grades.

In comparison with other mordants the amounts of actual titanium salt required are very small indeed, no addition of strong acid, such as sulphuric acid is necessary, and after the titanium oxide has combined with the material treated the very small amount of oxalic acid freed from the double salt is mainly in the bath and the rest is easily washed out if necessary.

The solutions are applied in the drum, paddle, tray or by brushing on. Acid dyes may be used in the same bath. Retanning with sumac, quebracho, gambier, bark extract, etc., may be done in the same bath with the titanium mordant. The titanium goes on very evenly and very rapidly, ten minutes in the drum being ample time. If the mordant bath has not been exhausted, which seldom is the case, a washing should be given before applying basic colors. Usually the mordant is all taken up by the leather, and in such case, after running off the liquor, basic colors run in without washing give most excellent results. Time is saved all along the line.

When titanium salts are applied to vegetable-tanned leather or to a chrome leather lightly treated with some tannin, or to a combination chrome leather, the titanium unites with the tannin of the leather to form a yellowish brown titanium tannate, which combines with the fiber of the leather and which is fast and stable and brings up subsequent colors in a remarkable way.

This yellowish-brown color of titanium tannate is a fortunate thing for the leather dyer, the similar antimony salt being colorless, and therefore the leather, in addition to being mordanted with the better mordant in preparation for the subsequent dyeing, is already, without any dye, given the yellow base necessary when all shades except lilac, gray and purple tones, are wanted.

All shades of yellow, tan, brown, green, red, maroon and of dark blue are thus ready for dyeing to shade.

The saving in cost by removing the necessity of using any Philadelphia yellow is easily seen, the saving of time is also noticed. One-half per cent. of the weight of the leather is

plenty to give a yellow mordant base on which both acid and basic colors dye freely and evenly and rapidly. The peculiar life of this base brings up the colors finely and full rich tones are obtained. The shade of yellow-brown produced varies with the kind of tannin in the leather, sumac usually giving the more yellowish shade. Young fustic with titanium gives a light tan. Gambier and fustic red shade give browner tans with titanium.

Example:—For one hundred pounds dry vegetable-tanned goat, sheep, calf skin, etc.—Drum with solution of 8 ounces titanium-potassium oxalate in warm water ten minutes. This gives yellow-brown base. Run in usual acid dye solution to bring to shade wanted. Wash and fat-liquor.

If basic dyes are to be used, drum ten minutes with the titanium solution, run off the liquor, wash the skins, and then run in the usual basic dye solution to shade. Wash and fat-liquor the skins.

The statements of Procter and of Lamb are borne out by the experience of dyers every day. Procter says that "titanium salts with coal-tar colors for dyeing chrome leather" have "many advantages over the ordinary mordants, the colors produced being faster to light, rubbing, fuller in shade and with much less tendency to 'grinning.'" The colors for bag, hat and bookbinders' leathers, as well as the chrome light tan colors for glove and shoe uppers, are produced far cheaper, better and quicker by using the small amount of titanium-potassium oxalate required than by any other method.

Example:—For one hundred pounds of wet chrome-tanned goat, sheep, calf skins, etc.—Neutralize the skins with borax or soda if necessary and wash well. Treat lightly with some tannin (sumac) in drum as usual. Run in solution of 4 ounces of titanium salt in hot water and drum 10 minutes. Then run in the usual acid dye to shade, or wash and run in basic dye to shade as usual. Wash and fat-liquor.

For Black Leathers with Logwood.—The same property which makes titanium hang to its oxygen with titanous grip in the ore state, and makes it difficult to convert into chemical

salts, makes titanium a "non-oxidizer." It does not yield its oxygen at all. Most metals give up oxygen with greater ease. Iron does, which makes it very valuable in many industries. But in logwood blacking of leather this weakness of iron is very bad. Leather blacked with logwood and iron on exposure to light goes through the following process: The iron gives up a part of its oxygen, oxidizing the leather. Then in the dark it absorbs more oxygen from the air, and the process is repeated. Iron is an oxygen-carrier. This continual slow oxidation of the leather finally makes it brittle or "friable," as Procter says. It is thus of great importance to use the least amount of iron which will bring the black. It is of as great importance to use none at all if durable leathers are wanted.

A better black as to color and a far better black as to durability is obtained by using titanium-potassium oxalate in place of iron liquor.

If a black surface is wanted it is better, as well as with iron, to apply the logwood solution first and then the titanium striker. Very little titanium salt is required, far less than the usual amount of iron salts.

Example:—For one hundred pounds of dry vegetable-tanned skins.—After the logwood (slightly alkaline) is on, run into the drum 8 ounces to 12 ounces of titanium-potassium oxalate (according to the kind and thickness of skins) in warm water and drum five to ten minutes. Wash, fat-liquor and finish as usual, but have about 1 pound of titanium salt in a barrel of seasoning and no copperas.

If the black is required to run deeper or right through the leather, many dyers drum with about half the amount of titanium salt first, then with logwood, and top with the rest of the titanium salt.

Logwood blacks on chrome-tanned skins are quickly produced, and are of a very permanent and durable character, by using titanium salt as a striker.

Example:—For one hundred pounds of wet chrome-tanned leather proceed as above, using about 4 ounces to 6 ounces

titanium-potassium oxalate in solution after the logwood. Finish as usual, but have about 1 pound of titanium salt in the barrel of seasoning and no copperas. Even when iron is used with logwood, a few minutes' drumming with a weak titanium liquor before striking with the iron liquor gives a better black color. Lamb says the blackness of chrome leathers may by this treatment "be greatly accentuated."

Replacing iron liquor entirely with titanium salt solution, however, prevents tendency to spue. Blacks with aniline colors are wanted with some leathers. A very fast and blue-black is made as follows:

Example :—For two hundred and fifty pounds of dry vegetable-tanned skins, lightly retanned.—Blue-black by drumming with methyl violet, 8 ounces; then fat-liquor in the drum. Then run in a solution of aniline black with green cast, 4 ounces to 6 ounces, and solution of titanium-potassium oxalate, 4 ounces, and drum about 10 to 15 minutes. Remove, season and finish, using 1 pound titanium-potassium oxalate in a barrel of seasoning, and no copperas.

In this case, washing before finishing is often considered unnecessary, as the amount of the mordant was so small.

Chrome-tanned leathers, if lightly retanned with some tannin extract, and then treated as above, give beautiful black grains and blue blacks.

Titanium-potassium oxalate is unique in several ways for the leather dyer. For the dyer of colors it provides a beautiful base for coloring and thus saves dyestuffs, at the same time cutting out one process and saving valuable time. And the wonderful grip the metal has, which renders it so difficult to manufacture into its salts, is that particular quality which makes it such a powerful mordant, producing colors and blacks faster to all deteriorating influences. It is a non-oxidizer and does not render the leather liable to become brittle. And a small quantity does the work of much more of the mordant.

It is also an American product manufactured by the Eastern Chemical Company in Boston. As the leather dyer wants first:

the quality of his goods high, and next such rapidity as is consistent with good work, American dyers are more and more appreciating the value to them of the combination of color and mordant.—*From the Shoe and Leather Reporter.*

NOTES ON THE MANUFACTURE AND APPLICATION OF FAT-LIQUORS.

From the scientific point of view there is a great deal still unknown in regard to the action on the leather of those emulsions of soap and oil technically termed fat-liquors. While now used on many varieties of bark and combination tanned leathers, their application is due to the development of, and the use of, chrome leather. Indeed it is no exaggeration to say that the success of the chrome leather industry was dependent upon the discovery and application of the fat-liquors, and even to-day the use of a correct fat-liquor is vitally necessary for the production of a commercial product.

To a considerable degree the formulas for various fat-liquors are among the most carefully guarded secrets of a leather manufacturer, yet in the main the composition and method of preparation of a good quality of fat-liquor have become well known. Practically then a fat-liquor may be defined as an emulsion of oil and water usually containing soaps and frequently other emulsifying agents. The purpose of the fat-liquor is to fill or nourish the leather and keep it from drying hard and brittle, but just how this result is effected is not wholly understood. Some good authorities have stated that the chrome tannage is really a mixed mineral and oil tannage and that the fat-liquor should therefore be regarded as a tanning agent. There are reasons for and against this view. In the old days of bark-tanned leather, the use of oil in finishing or currying was certainly an essential part in the production of merchantable upper leather. Such oils as were used, however, were put in as oils or grease, *i. e.*, the leather was stuffed, to use the technical term. The oil or grease was never considered as acting as a tanning material, but rather as a lubricant and waterproof filling and coating to preserve the leather.

It is presumable that Robert Foerderer, the inventor of vici kid, the first merchantable chrome leather, was the real inventor of the emulsified fat-liquor, although the claim has never been put forward, yet according to all evidence it was the use of the fat-liquor that made vici leather far superior to the attempts of other leather manufacturers. When the knowledge concerning the use of emulsion of oil commenced to leak out, other manufacturers began to make good chrome leather. Before going further into the why and wherefore of fat liquors it will be perhaps well to consider a little their general constitution and preparation.

Emulsion.—An emulsion is a mixture of liquids which are mutually insoluble, but which are so mixed that fine particles of one are suspended in the other. The term is usually, although not necessarily, applied to mixtures of oil and water. Milk is often cited as the most perfect type of an emulsion. In order that an emulsion may be at all permanent, it is in general necessary that a third substance, called an emulsifying agent, be present. Such emulsifying agents act by increasing the viscosity of the one liquid in which the fine particles of the other are suspended to such a degree that the tendency to separate into different layers is largely overcome. In the case of milk the casein and milk albumen act as emulsifying agents. In the familiar examples of cod-liver oil emulsions of the pharmacy, the emulsifying agent used is gum acacia or gum arabic. For the purpose of leather manufacture it has been found by experience that neither the casein of milk or gum arabic, or indeed any other gum, acts suitably as emulsifying agent in fat-liquors. Primarily they make trouble by perceptibly stiffening and harshening the leather, and then their power to increase viscosity rapidly diminishes with a slight increase in temperature. Soap is therefore largely used as an emulsifying agent in the preparation of fat-liquors. Regarded simply as an emulsifying agent it is not especially effective, but it has the extremely important advantage—provided the right kind of it is used—that it does not injure the leather. To increase its

efficiency two other emulsifying agents are used, namely, egg yolk and sulphonated oils. Egg yolk is itself an emulsion, and the emulsifying agent in it is known as vitellin, an albumen having great resemblance to casein. Presumably because the proportion of oil and albumen in the egg yolk to the water contained in it is greater than in milk, and it can therefore be used in relatively greater proportion, it is much more efficient than milk in a fat-liquor.

Sulphonated Oils.—The subject of sulphonated oils, or acid fat-liquors, as fat-liquors containing these treated oils are called, is a large one and can be but briefly considered here. The best known sulphonated oil is Turkey red oil. This is made by the action of sulphuric acid on castor oil. It is largely used in the textile industry, especially in the dyeing of Turkey reds, hence the name. Its preparation really requires considerable care, and it is best manufactured on a large scale in factories making a specialty of its production. However, as leather manufacturers making use of it have very generally desired to keep the fact secret, they have endeavored to prepare it themselves rather than purchase it from an experienced maker. Such manufacture is usually attempted with imperfect apparatus as well as imperfect knowledge of the subject. In the first place castor oil is practically the only oil that can be sulphonated in the true sense of the word because the principal fatty acid contained in it is ricinoleic acid, an unsaturated acid.

This statement does not mean that oils other than castor cannot be treated with sulphuric acid and some sort of a product obtained, nor should it be understood that it is impossible to sulphonate fatty acids other than ricinoleic acid, but under the conditions under which castor oil is sulphonated it is impossible to substitute other oils and get an analogous product. For example, the fatty acids of linseed oil are largely unsaturated, but unless extraordinary precautions are taken to cool the mixture of acid and oil, the reaction is so violent that what is known as secondary reactions take place and the fatty acids are largely destroyed.

Rather than attempt to sulphonate linseed oil, which from its well-known drying nature, *i. e.*, tendency to become resinous, does not recommend itself as a good leather lubricant, a much more common practice among tanners is to treat oils—for example, neatsfoot and tallow oils—whose fatty acids are principally acids of the oleic acid class, with sulphuric acid. Now it is possible to sulphonate oleic acid, but not under the conditions usually employed in the tannery. Oleic acid only sulphonates at a high temperature, and when an attempt to sulphonate one of the oils which consist largely of it is made, no sulphonation at all, or practically none, results, but by hydrolysis the oil is simply broken up and separates into its constituent parts, viz, fatty acid and glycerine. For some purposes in a fat-liquor it may be desirable to have as constituents a free fatty acid and glycerine, but these products do not perform the same functions as a true sulphonated oil—that is, do not act as emulsifying agents.

Casein.—Casein has been employed as an emulsifying agent, but the fact that it is only soluble in alkaline solutions makes its use objectionable. Also the extreme liability of its solutions to putrefy is a disadvantage, especially as the usual antiseptics precipitate it. Probably the most satisfactory preservative for casein solutions is white arsenic; only a very small quantity is needed, and the trace of arsenic that will remain in the leather is so infinitesimal that no objection can be raised to its use. One part of arsenic to two thousand of fat-liquor is a proportion that has been employed with success.

Egg Yolk.—Egg yolk, as previously stated, is very generally used, and forms a valuable constituent of fat-liquors. It is itself an emulsion in which an albumen similar to casein is the emulsifying agent. Probably one reason for the superiority of egg yolk to casein is, because in the case of the latter the natural emulsion is broken up, while egg yolk is used in an unchanged state. There is sufficient excess of albumen in egg yolk over that required to emulsify the natural oil it contains to enable it to be used in fat-liquors and hold large proportions of other

oils in a state of emulsion, and it is for this purpose that it is of value in fat-liquors. Unfortunately some dealers in egg yolk, acquainted with this fact, often add other oils to it. These oils of themselves are not necessarily deleterious to the fat-liquor, but inasmuch as by their presence the emulsifying power of the egg yolk is reduced, they are rightly considered as adulterations. Still more reprehensible is the practice of sophisticating egg yolk with emulsions of oils and casein which are colored by aniline dyes. An easy test for adulterations is the addition of a small amount of ammonia to one portion of a suspected sample, and a small amount of acetic or muriatic acid to another. If the addition of either, the ammonia or the acid, makes a very decided color change in the egg yolk it indicates the presence of an aniline yellow, and presumably an adulterated product.

Potash Soaps.—Potash soaps are preferably used as the soap constituent of fat-liquors. The reason for this is that they are soft soaps, that is, have a low melting point, while that of the hard soda soaps is higher. The objection to the high melting point, or perhaps to express it another way, the low solidifying point of the soda soap is that it causes white specks or soap crystals to form in the leather, which is one variety of the familiar "spewing," a specially annoying defect in finished leather.

While all potash soaps are softer than the corresponding soda soaps, *i. e.*, soaps made from the same kinds of oils or fatty acids, a potash soap made from a solid, hard fatty acid will be nearly as hard as a soda soap made from a liquid fatty acid such as oleic acid. Also if a soda soap is made from a liquid fatty acid and a large percentage of water allowed to remain in it, it will closely approximate the appearance of a potash or genuine soft soap. A simple drying test will serve, however, to distinguish the true from the false. As above explained, a soda soap, in order to appear soft, must contain a high percentage of water, and this water will evaporate if a small sample of the soap is exposed for a few hours to a gentle heat in a shallow dish on a radiator or uncovered steam pipe,

and leave the soap hard and dry. The potash soaps, on the other hand, will never dry out hard unless made from a very hard fat.

Fig Soap.—A soap that has had much vogue for fat-liquor purposes is the so-called fig soap. It was originally a potash soap made from olive oil foots, that is, the crudest residual oil. Such foots contain a considerable amount of unsaponifiable matter, largely phytosterol, and this gave to them a consistency similar to fig paste, in which, on long standing, soap crystals formed, which increased the semblance to fig paste by giving the appearance of seeds. Much of the fig soap now offered is made from a mixture of olive oil foots, cotton seed oil and tallow, and is much superior in appearance to that made exclusively from olive oil foots, as the tallow forms much harder soap crystals than occur in the original fig soap, and the cotton seed oil is naturally of a lighter color than the foots, and consequently the soap is clearer as well as having a more seedy appearance.

For practical use a soap is probably better made in the old way, as the hard stearic acid soaps (from the tallow) will crystallize in the leather as well as in the soap and cause spueing. The tanner should be especially warned against the use of rosin oils. These oils are obtained by the distillation of rosin, and, while they are saponifiable, the soaps so formed have few of the properties of ordinary soaps and are not available in fat-liquors as they have so little emulsifying power.

The free fatty acids of rosin in oils are objectionable as they oxidize and become resinous or gum. Some sulphonated rosin oils have been offered for fat-liquor purposes, and while the writer has not had the opportunity to experimentally examine them, from theoretical considerations there does not seem any reason to suppose that they will have sufficient efficiency to replace the higher priced castor oil compounds.

A final word in regard to fat-liquors as to the question of alkalinity or acidity. The first fat-liquors were essentially alkaline, because of their large soap content; the sulphonated oil

compounds, on the other hand, have an acid nature. Now if alkaline and acid fat-liquors are mixed, as frequently has been the case, the possible good effects of either used separately are nullified.

The effects on colors and stains should be considered also and especial cognizance taken of the fact that an acid fat-liquor has much less effect on colors.—(*The Shoe and Leather Reporter.*)

REMOVING SPOTS AND STAINS FROM LEATHER.

When spots and stains get onto colored leather it is not an easy matter to remove them so that they will not show. Practical experiments have proved the following methods to be the most effective that can be used.

Colored leather that is simply soiled or dirty and not stained may be washed off with warm Castile or Ivory soap suds; then dried and rubbed. Or a little acid may be added. The acid must be very mild and applied very carefully. A dirty water stain is sometimes taken out with the juice of a lemon, which is the mildest acid that can be used. Vinegar also is employed for water and other stains.

An oil spot may be removed by dipping a piece of rubber in naphtha and rubbing over the spot. Another way is to cover the spot with cement, such as is used in shoe factories. After the cement has dried for an hour or a little longer, rub or roll it off with the finger. If a little is left, go over it with the rubber dipped in naphtha.

For general dirt from the hands, a little oxalic acid well diluted may be used. Wash the dirt off and then wash with soap and water and perhaps apply a little of the finish. An aniline stain cannot very well be taken out; but it can be helped somewhat with a rubber. Some of the aniline can be washed off with a regular wash, as with soap and water. However, the stained part of the leather cannot be made to look like the rest because it has soaked through more or less. It depends much upon the leather as to how far aniline will penetrate. Some

sorts have a hard surface and the aniline does not penetrate far, while others are soft and the stain goes right through. There are various preparations on the market that shoe manufacturers use for stains and some of these are employed to clean and polish vamps in one or more operations. Leather that becomes stained or discolored should be recolored into black stock.

Grease spots that sometimes get onto leather from oil from pulleys or shafting may be taken out with shoemaker's cement and chalk. Put the cement on first, then lay the chalk on and work both into the leather with the flat of a knife, or by any other means. The cement will eat into the grease, and it should stay on until the grease comes out, even if it takes twenty-four or forty-eight hours. Use pure rubber cement for this purpose, for a cheap article is apt to stain the leather. The cement will dry after a little time so that it can be rolled off.

Another method is to place a piece of cloth or some cotton waste saturated with naphtha over the spot. This is covered over with another cloth to prevent too rapid evaporation. More than one application may be necessary for the grease or stain must dry out gradually. It is the naphtha in the cement that is supposed to remove the grease; and it might be applied in any other form, provided not enough is used to bleach the leather. Slight spots may be rubbed out dry with a saturated cloth. Ether is also sometimes used.

White ooze leather, and possibly also white grain leather, that has become soiled may be cleaned with salt of sorrel in the following manner: Cold water is applied to the leather, washing it all over. A mixture of salt and lemon juice or salt of sorrel, so-called, which can be secured at any drug store, is then rubbed over the soiled portion, with the result that all the spots, stains and dirt marks disappear and the leather is once more white. The leather must always be washed over with water, which must be rubbed over the entire skin; but the mixture of salt and lemon juice is applied only to the soiled portion.

HOW TO RETAN CHROME LEATHER.

When making chrome leather the tanner should always be sure that his hides or skins are fully tanned before any attempt at coloring and finishing is made. If tanning was begun early in the day, the leather should be tanned before quitting time at night; but if it is not completely tanned, enough cold water should be added to the liquor in the drum to cover the leather. The drum should be run five minutes to mix the water with the tan liquor; and the leather should then be left in the liquor until the next morning. Then run the drum for an hour; remove the leather and place it over a horse for twenty-four hours. Provided sufficient tanning material was used, this treatment will insure leather that is completely tanned.

Light skins and the grains of split hides do not require re-tanning except with gambier, palmetto or sumac for colors. The vegetable tan not only acts as a mordant for the dye but also serves, to some extent, to retan the leather. The process is as follows:

After washing, the leather should be struck out or pressed and shaved. For each hundred pounds of leather from two to three pounds of gambier or of palmetto extract are used. Dissolve the material by boiling it in six gallons of water; then add six gallons of cold water. Drum the leather in this liquor for forty-five minutes or an hour, and it is then fully retanned and also in good condition to be colored. While not always necessary, it is well to dissolve and add to the liquor in the drum at the end of the time stated, a few ounces of tartar emetic to clear the grain and set the dye. This treatment is not required for black leather but with colored leather it helps materially to get uniform coloring. More gambier than the quantity mentioned should not be used or the grain will be made tender and the leather will have the appearance of vegetable tannage.

Hides that are to be split after tanning, should be tanned in a paddle wheel or suspended in the liquor in a vat, then pressed and split. When they have been pressed, mill them in a dry

mill until they are opened up ready to split, then jack them the same as for bark splitting. After they have been split, the grains almost invariably need shaving and retanning. To each hundred pounds of leather dissolve five pounds of salt in ten gallons of water and drum the leather in this solution ten minutes. Then add three quarts of chrome liquor and drum three or four hours; then horse the leather up for twenty-four hours and wash it in the usual manner. The grains can be colored blue or black while they are being retanned by adding to the chrome liquor sufficient nigrosine and drumming as directed. Subsequent dyeing with logwood is necessary as the nigrosine simply colors the flesh and prepares the grain for the subsequent blacking.

After being washed, the grains are in condition to be mordanted with tannin or dyed with logwood and striker if black leather is wanted. A light retanning with some vegetable tan is also good for black leather as it gives a fine grain and deep black.

It is impossible to finish chrome leather that is not fully tanned, as the raw fibers in the center dry hard and bony and it cannot be made soft by oiling and staking. The only thing that can be done is to drum it in a strong, hot salt solution for two hours, then drain off the solution and add salt water, and to this some one-bath chrome liquor, and drum the leather at least two hours to be sure it is retanned. The preliminary drumming in hot salt water softens the leather so that it will take up the chrome liquor. After it has been retanned it should be washed, given a little more fat-liquor, and dried. When dry, stake and finish with a boarded or dull finish. Tacking on boards to dry is necessary to stretch the grain smooth and to draw out the wrinkles that are caused by retanning.

The more thoroughly grains and skins are tanned the more easily they color and finish and the more satisfactory the leather is when it is finished.

HOW TO TEST NEATSFOOT OIL.

Take a four-ounce vial or a regular oil sample bottle and fill it with oil; then place the bottle in the can of an ice-cream freezer. Prepare a mixture of ice and salt of ten parts ice and one part salt, proportions estimated on weight of ice used. Surround the can with this mixture. Insert a thermometer in the opening at the top, and when the air-chamber surrounding the bottle has reached 20 degrees Fahr. keep it at that temperature for four hours. If after that period of time the oil will flow when the bottle is inverted, it is a good twenty-degree oil and one very suitable for oiling, or to be used in any other way on leather. If the oil is hard and looks like so much lard, soften it by allowing it to stand for an hour or so at the ordinary temperature of a room and make another experiment, this time allowing the oil to cool to 25 degrees. In this way the cold test of the oil can be determined. Great care must be exercised in this experiment as in all others, as accuracy is the first law of success. See to it, therefore, that the thermometer is accurate. Get a good one from any house that supplies chemical apparatus. The cold test alone does not determine the quality and grade of the oil. It only helps to arrive at the final decision when the other tests are made. The next experiment is the Maumené test. In a beaker of 100 c.c. capacity, weigh off exactly fifty grams (28.35 grams in one ounce) of oil and add to this amount exactly 10 c.c. of chemically pure concentrated sulphuric acid of specific gravity 1.84, stirring constantly with a Centigrade thermometer. Take the temperature of the oil before any acid is added and then record the temperature after the acid has been added and the oil stirred for a few minutes. During the addition of the acid a gradual rise in temperature will be noticed, caused by heat being generated by the change of the oil and acid into sulphonated oil. This rise in temperature should be high if the oil is a pure animal oil, and yet not too high, because the rise in temperature for a pure neatsfoot oil is between 45 and 48 degrees Centigrade. If the rise is higher or lower than the figures given adulteration may be suspected.

The mixture in the previous experiment should not be thrown away but poured into a 100 c.c. graduated cylinder and set aside for about two days. If there is mineral oil present in the sample under examination, it will separate out when standing for that length of time, as sulphonated oil does not unite with mineral oil. By this method it is possible to determine the amount of mineral oil.

Also purchase with a thermometer for oils a hydrometer which records readings from .908 to .938 and with this instrument take the specific gravity. A pure oil ought to record between .915 and .918. Anything higher or lower is indicative of an inferior product.

While these tests are not absolute proofs of the quality of the oil, yet if good judgment is used in the matter, they will be sufficient to say whether it is safe to use the oil or not. There are many houses selling oils but few are handling the pure 20-degree oil which is the best for the leather trade. No tanner can afford to use anything but the best neatsfoot oil.

A PROCESS OF FAT-LIQUORING.

Black as well as colored leather, especially chrome tanned, is treated with different fats or oils, and also with albumen, for the purpose of softening and filling. The object is to have these substances as finely divided as possible in a watery solvent in order that they may enter the minutest pores of the hide, filling them through and through. These fats and oils are generally prepared with alkaline substances, such as soda, borax, etc., which are cooked together. But in order that the skins may retain their natural chemical and physical properties as little alkali as possible should be used.

Attempts have been made to increase the quantities of oils and fats in these soap liquors, and special apparatus has been employed to make more perfect the amalgamation of the ingredients. Some of these appliances have worked well, as the soap liquor becomes greatly enriched with the fat, but a considerable quantity of soap is always required. Soaps and

soaped oils are injurious to the leather and must always be washed out or the leather will spew. Where hard lime water is used this difficulty becomes more pronounced.

The writer has discovered how to produce a fat-liquor that contains no soap and only the smallest possible quantity of soda. The liquor he makes contains but one per cent. of the fat weight of soda. The fat remains in its purest natural condition, and therefore yields the highest results and can be mixed with water without the aid of machinery. Of course these fat-liquors may be improved with an emulsifier, and when large quantities are consumed the use of this apparatus is recommended. With some changes these new fat-liquors may be also used upon bark, extract or alum tanned leather, but they are especially prepared for use in connection with the chrome tannage, and should be applied in the following manner: Washed skins should be handled in a drum with warm water in order to heat them. While the drum is in motion add the first liquor, which should have been previously diluted with water. The drum should be revolved ten minutes, when the oil will be absorbed by the skins. It is easy to determine whether all the oil has been absorbed by noting that the liquor, which was previously clouded and milky, has now become as clear as water. This first liquor, which consists of an emulsion of rosin oil with a little starch, is used to render the skins fine and soft and to prevent them coming out in a condition which may be described as a "greasy dryness." Colored skins assume a brighter luster by this process.

Skins that have been colored after going through the first liquor are washed in cold water, then a short time in warm water, and after this fresh water is turned into the wheel.

The second liquor, which has previously been diluted with warm water, is then poured into the wheel, which is revolved for one-half an hour. The fluid should then be as clear as water, all the fat having been absorbed. The skins are then washed in warm water a short time, but this is not absolutely necessary, as the succeeding operations are continued in the

usual way. The choice of fat must be made according to the amount of filling, softness and luster wanted in the finished leather.

The new fat-liquors are prepared as follows, for 100 pounds of hide weight. The first liquor, which consists of rosin oil to the amount of one-half per cent. of the hide weight is compounded as follows: In one quart of soft water at 70 degrees C. (158° F.), 20 grains of soda are dissolved. Add to this 30 grains of potato starch, previously kneaded into dough with one-half pint of lukewarm water. Then one-half pint of rosin oil is slowly added. The milky solution thus obtained may be diluted as desired with warm water. Should the skins be hungry, a double quantity of soda and starch may be given. The second fat-liquor is made thus: In two quarts of warm water 40 or 50 grains of soda are dissolved, and to this solution 60 to 75 grains of potato starch, previously kneaded into dough with lukewarm water, are added. Then one pint of heated rosin oil is slowly added. Into this emulsion, which is similar to the first, the fats and oils, which must first be heated, are slowly poured. For example, to obtain good, full leather, with a fine feel and softness and of medium luster, one pound of soda oil or degreas, or a mixture of both, one to two pounds of neats-foot oil and one pound of vaseline oil are added. If this mixture is properly prepared no oil or fat will float in the milk. But should oil or fat be found floating on the surface, a little more starch and soda should be added. The process is simplified by running the solution through an emulsifier. In order to impart the Russia leather scent to the leather a little birch oil may be added to the emulsion.

The fat-liquors should never be boiled and should also be guarded against cold. They must therefore be kept in a warm place, as in both cases (boiling and chilling) the oils and fats separate in large drops or lumps. They should also only be mixed with warm, not boiling, water, and applied to warm skins, the latter being kept warm until finished (dry), or at least until the setting-out. The fat-liquors keep in a warm

place, especially if they have passed through a good emulsifier, without being altered, for several days; one can therefore make a stock. The stock of preparatory liquor is best kept for itself, and one can take the necessary quantity from it for the finish liquor.

Good fat liquors are also made by using castor oil in place of rosin oil.—Dr. Carl Dreher in *Schuh and Leder*.

THE RECOVERY OF CHROME RESIDUES.

In the two bath method of chrome tanning the first bath, which contains an acidified solution of bichromate, is never completely exhausted. It has been frequently proposed to utilize the residual chrome in this bath by making use of a standing bath, that is, never wholly discarding a bath, but adding to it each time a quantity of bichromate and acid sufficient to restore its original constitution. Unfortunately this renewal of the bath is an extremely complicated matter.

The method of a standing bath, while possible in dyeing, seems to be impracticable in tanning, because a small variation of the ratio of its different constituents to each other or to the volume of the solution exerts a strong influence on the condition of the leather. Possibly when the influence both of the neutral salts, and the acid and chromium compound are more perfectly understood and the analytical methods for determining them are more accurately established, it will be possible to avoid the waste of chrome, which takes place when these first liquors are run away, by using them over and over again. With our present knowledge, however, it is probably more practical not to try to utilize this chrome again in tanning and produce thereby a poorer leather, thus saving at the spigot, as it were, and losing at the bung, but to recover the chrome in some form which would make it available for some other purpose.

Two processes for the recovery of chrome as a by-product have been proposed, both of which can be worked profitably, provided proper care is taken and the work of the tanner is on

a sufficiently large scale to warrant expenditure for labor. The first process consists in the precipitation of the chrome as chromate of lead or chrome yellow. There is an extensive demand for this pigment and the particular shade is not of very great importance so long as it runs strictly uniform. In order to obtain uniformity the precipitation should be always made under as near the same conditions as possible, and to obtain brilliancy the solution should be filtered before precipitation takes place, and some alum added as a clarifying agent. White sugar of lead should be used for precipitation. A filter press is absolutely essential to collect the precipitate. The product may be dried or sold in the pulp form to mixed paint manufacturers. The price which is obtained for the chrome yellow would depend on the care with which it is made, but with ordinary precautions taken this working up of a by-product should be fairly remunerative.

The second method of utilizing the waste chrome is to reduce it with sodium bisulphite or sulphurous acid gas, precipitate with soda ash, collect in a filter press the chrome hydrate so formed, wash it thoroughly, and use for the manufacture of one-bath tan liquors. This method is in many ways preferable to the manufacture of chrome yellow as it does not involve the looking for an outside market with any of its attendant bothers. In order to conduct even this recovery of chrome profitably, the liquors must be analyzed and no great excess of reducing agents or soda employed, as otherwise these chemicals may be wasted and no real gain obtained.

OILING CHROME LEATHER.

The finishing of chrome leather cannot be called currying, since no heavy stuffing or hard grease is used, the only grease that the leather receives being an emulsion of oil, soap and degrease, or some other suitable material, and a coat of oil applied to the grain before it is dried. The oils that are suitable for the grains of chrome leather are neatsfoot, olive, sperm and paraffine. Neatsfoot oil is often used alone although it is also

mixed with paraffine oil. A good mixture for chrome glazed leather is one part neatsfoot and three parts paraffine oils; and for dull-finished leather equal parts of the two oils. The oils should be warmed, mixed and applied warm to the leather with a sponge. The leather should be thoroughly struck out with a slicker before it is oiled.

Another good combination is one part olive and three parts paraffine oils. The mixture should be applied evenly over the grain, more being put on for a dull finish than for a glazed one, since too much oil makes the grain too soft and greasy to glaze clear and bright. It is best not to touch the flanks when oiling the leather. Sperm or olive oil is good for colored chrome leather.

A pure petroleum oil, such as 34 gravity neutral, is good for any glazed leather. Good results are obtained by mixing it with what is known as fleshing oil, using equal parts of the two oils. Heat the oils to 200 degrees Fahr., mix them well and let them cool before use.

To preserve the finish and prevent spewing a coat of the petroleum oil heated to 100 degrees Fahr. should be applied to the leather after it has been finished. Finishing and kid oils, so-called, are nothing but 34 degrees neutral petroleum oil, although they are generally sold under fancy names at fancy prices. Fleshing oil is much cheaper than neatsfoot and produces equally good results.

The paraffine oils, when used together with pure cod oil, in proper proportions, are very satisfactory for sole and rough leathers. The proportions of the two oils should be from 25 to 60 per cent. paraffine oil and from 40 to 75 per cent. cod oil. A good mixture is made of 40 per cent. cod and 60 per cent. paraffine. The regular 28 degree paraffine oil is the most suitable for rough and sole leathers.

There are also several specially treated neatsfoot, cod and olive oils on the market that have great softening properties, prevent spew and gum, and do not discolor the most delicate colored leather.

Low grade oils should never be put onto chrome leather. They undergo a process of fermentation in the leather, give it a bad odor and spew out upon the surface in the form of white scum that is very difficult to remove. It is advisable to use the best grades of oil, especially for oiling the grain, since the quantity put on is small and the difference in cost is not worth taking into account when the quality of the finish is considered.

FORMIC ACID IN LEATHER MANUFACTURE.

In Coloring.—In the dyeing of leather with acid dyes it is customary and necessary to use sulphuric acid in the dye bath to get the shade. The acid remains in the leather and brings about gradual deterioration, which is especially noticeable in book-binders' leather, but is also true of every other kind. Sulphuric acid may, to very great advantage, be replaced by formic acid. Formic acid, after dyeing, is entirely removed from the leather by evaporation, and hence is harmless after it has served its purpose in the dyeing operation. The advantage of this property is so great that the comparative cost does not come into consideration. A certain amount of acid will bring out the maximum depth of shade. In using formic acid no harm is done to the leather, even if the amount required is exceeded, as the acid evaporates during the drying of the leather. But when sulphuric acid is used the maximum quantity of acid required to bring out the full depth of color cannot be used, as it cannot be washed away after coloring, and it does not evaporate, but remains in the leather and weakens its strength. In the dyeing operation it is necessary to use just twice as much formic acid as sulphuric acid, otherwise the process is the same.

For the purpose of removing iron stains from leather and to clear it and make it as light-colored as possible sulphuric acid is used. The leather is drummed in a very weak solution of the acid, then washed and colored. Other acids, such as formic, lactic, acetic, tartaric, citric and chromic, are without effect in this process. Oxalic and hydrochloric acids answer

the purpose but injure the leather. Hence sulphuric acid cannot be dispensed with for this purpose; but in the actual dyeing of the leather formic acid may be used, it being the only organic acid that will produce a depth of shade equal to sulphuric acid, and with no damage to the leather.

In Finishing.—When leather is to be glazed the surface grease must be removed. For this purpose a dilute solution of formic acid may be used. The acid is diluted with water and rubbed into the grain of the leather, which is then dried. When dry, the grain should be rubbed with a soft cloth and then be given the first coat of seasoning. The acid cuts the grease and makes the grain clean and dry, so that a clear, bright finish can be obtained.

In Pickling.—Skins, after they have been drenched or bated, may be kept indefinitely by being pickled in a weak solution of formic acid and then placed in a strong solution of common salt. For the acid bath one pound of formic acid may be used to every twenty-five gallons of water. After the skins have been permeated with the acid they should be allowed to drain several hours and then be placed in a solution of salt. This process gives them a darker color than the sulphuric acid pickle but has advantages that offset that of color, the chief one being that the acid has no detrimental effect upon them. Glauber's salt may be used in place of common salt with slightly better results. Skins pickled with this process never mildew or mold; they can be tanned in a sweet liquor after very slight washing in cold water, just sufficient to remove the salt.

In Drenching.—A mixture of four parts formic acid and one part lactic acid makes a good bate or drench in which to delime skins. Less than one-half pint of the mixed acids is sufficient for one hundred washed skins. The temperature of the drench should be about 90 degrees Fahr., the goods being processed in it for one hour or longer. The drench also produces good results when used after skins have been partly bated with manure. After drenching, they should be washed and

then pickled or tanned. When drenched with formic acid they tan out into very clear and uniformly colored leather.

In Plumping.—Formic acid also renders service in the tanning liquors where it plunges the hides and makes them more receptive to tannin. To secure good plumping in heavy hides the acid should be added to the second, and even the third, and fourth, liquors. As the hides swell they absorb tannin and the liquors must therefore be watched to prevent exhaustion of their tanning strength. The formic acid acts as a preservative to hides and liquor; the plumping is a natural one so that the color as well as the yield and quality are very satisfactory. The acidity of a tanning liquor does not, as a rule, exceed one-half of one per cent. and it is not difficult to determine the quantity of acid that should be used to obtain the percentage of acidity. The weaker liquors in a tannery, such as handlers, hangers or rockers, do not require over one-quarter of one per cent. acidity to obtain good plump leather. The action of formic acid on the hides is quick and penetrating. It also prevents any putrefaction that might take place in the weak liquors. Unlike lactic and sulphuric acids, it is volatile and can be removed from the liquors by passing them through a heater on their return to the leach house. A little formic acid in water makes a bath in which sweated hides may be immersed to arrest putrefaction and preserve them. A five per cent. solution is sufficiently strong for this purpose. No other acid serves this purpose.

METHOD OF DEPILATING WITH SULPHIDE OF SODIUM AND LIME.

The best results are obtained by combining sulphide of sodium and lime. The lime is slaked with hot water; in another tub from two to four pounds of sulphide is dissolved for each bushel of lime, and this solution is added to the lime and mixed with it. This mixture is then thrown into the liming vat with sufficient water for dilution, and the hides or skins are immersed in the liquor:

The better way to conduct the operation is to use a paddle wheel tub so that the skins may have their positions changed in the liquor without the necessity of hauling them out of the lime as in the other way.

The advantages of using sulphide of sodium are that it shortens the time usually required for the liming process; it makes the lime more soluble so that it is more easily washed and worked out of the skins; it produces a finer and softer grain and does away with the high, harsh grain so often apparent when lime alone is used. The skins should be washed, worked out and bated in the usual way after being removed from the lime.

METHOD OF USING PATENTED DEPILATORY CRYSTALS WITH LIME.

If it is desired to save the hair, the skins should be soaked and flushed and then have the water extracted from them by means of a hydro-extractor; or if no extractor is available, they should be drained thoroughly by placing them smoothly over a horse and leaving them thereon until the water is well pressed out. They are then painted on the flesh side with the depilatory reduced with hot water to 18 degrees Baumé strength and cooled, then folded neatly, flesh side in, and laid in small piles until the next day, when the hair can be rubbed off. After the hair is off, they should be limed a few days, then washed and bated.

If the hair is not to be saved, a liquor should be made by dissolving depilatory in water until twelve pounds have been used to every one hundred gallons. This liquor should be well stirred, the skins put in and left therein until the next day when the hair can be washed off and the skins limed. If dried stock is not thoroughly soaked before being put into this liquor it does not matter, as it can be left in it from twenty-four to forty-eight hours or until it is soft and plump. The hair can be washed off and the skins then limed for a few days in weak, clean lime liquor. Sulphide of sodium can be used in this manner also.

DISTILLATE TANNAGE.

Distillate tannage and its relation to, and advantages over, other methods of making leather will now be briefly considered. To fully understand the matter it is necessary to start at the beginning and present the theory. The sap of a living tree is the blood of the tree, diffusing substance and growth thereto. When the sap of the tree comes into contact with the air, or rather oxygen, it becomes oxidized into an acid, which accounts for its presence in the bark. Therefore, if the material which made an acid in the bark did not first exist in the wood, it would not occur in the bark. Thus it follows that in the wood itself is the bulk of tanning power which has been found to be eight times that of bark. The source of supply in distillate tannage, unlike bark, is not destroyed; the pruning of small limbs yields the material for distillation. In the process of distilling, a charcoal is produced which pays the cost of distillation, and the tanning distillate is in evidence at no cost.

Chlorine is next introduced to oxidize the distillate, and the tanning power of a tree is harnessed for work. This tannage does not mold, sour or decay, or change in any respect. It is a very powerful agent, and it will work in union with any vegetable tannage if desired. It will, in union with bark, produce sole leather in thirty days; and, when used in such a manner, double the capacity of any bark tannery. Straight distillate leather is the strongest leather produced. It will not harden or crack under any circumstances, and will give more wear than any other known leather. The cost of tanning is one-half that of bark or chrome; and it has produced side leather in nine days from the beam-house. Distillate tannage has been improved and developed until it does its work as rapidly as chrome and has some points of superiority over other methods of making leather. The leather may be dried and curried at any time. Its cost is much less and it is a standing bath. It will not rot or burn stock, and produces an oil-tanned leather in a class by itself. The odor of distillate tanned leather is easily changed in finishing.

FAT-LIQUORING WITH KROMOLINE S.

As practical tanners are aware, many of the troubles incidental to the manufacture of the lighter leathers are due to imperfect fat-liquoring or impregnating the skin fiber with oily products. Fat-liquoring is a comparatively modern introduction, and this being so, it is easy to see why the process has often proved a failure, even when the difficulties incidental to chrome tanning have been overcome. As a matter of fact, fat-liquoring depends on several important points which are either not understood or lost sight of, and as the process in practice has, as a rule, to be worked by operators of only average intelligence, it is important that it should be kept as simple in manipulation as possible. Many attempts have been made to introduce a fat-liquor that is more reliable and as cheap as the article manufactured in the tannery.

A preparation known as Kromoline S is proving to be useful on all chrome-tanned and vegetable-tanned goods. It is a fat-liquor which will not affect the shade produced in dyeing. For this reason it can be used after dyeing where no other fat-liquor is advisable, as it does not strip the color from the skins. It is also claimed for this material that skins will glaze up much better in finishing than in the case of ordinary fat-liquors. The penetration of Kromoline S is complete, so that with ordinary care it is practically impossible to over fat-liquor the goods.

Complete neutralization of the skins is necessary before fat-liquoring. Acid in the leather interferes with getting the best results of the process.

A general method of using the fat-liquor is as follows: For one hundred pounds of wet skins, take five to six pounds of Kromoline S; dissolve by mixing with four to eight gallons of fairly soft, hot water and then boiling the solution. Then run it in at 140 degrees Fahr. through the gudgeon onto the skins in the drum while the latter is in motion. Run the drum for forty minutes; then finish the skins in the usual manner. Kromoline S may be obtained of I. Levenstein & Co., 74 India St., Boston, Mass.

COLORING CHROME-TANNED SKINS WITH SULFAMINE DYES.

Chrome-tanned goatskins are very satisfactorily colored with sulfamine dyes. These dyes, when properly used, produce full, clear and uniform shades of color. They are not used in the same manner as aniline dyes. No mordanting with tannic acid is required. It is merely necessary to thoroughly wash the skins after they are tanned, in order to rid them of all salts and acids and to get them in perfectly neutral condition before applying the dye. The skins should also be free from grease. The dyeing may be done in drums or reels, such as are in common use. In order that the color may penetrate readily, a small quantity of carbonate of ammonia may be added to the dye liquor, but this must be neutralized afterwards by a little acetic acid.

The skins, after being colored, should be fat-liquored at once, the surplus water being, of course, struck or pressed out before fat-liquoring. The fat-liquor should be used at 120 degrees Fahr., and the skins drummed therein for at least thirty minutes. Care must be taken that the fat-liquor is neutral, that is, containing no excessive amount of alkali. Some dyes are readily injured by an excess of alkali in the fat-liquor. A very good neutral fat-liquor capable of imparting great softness and smoothness to chrome-tanned skins may be made by emulsifying egg-yolk and neatsfoot oil.

After the fat-liquoring is completed, the skins are struck out, given a light application of glycerine and water upon the grain, followed by a light coat of oil, and then dried out, staked, softened and finished.

DRENCHING WITH LACTIC ACID.

Sheepskins.—For an average weight pack of 800 to 1000 sheepskins, 20 pounds of lactic acid and 20 pounds of common salt are required. Ten pounds of lactic acid and all the salt should be added before the skins are put in; after they have been in fifteen minutes the rest of the acid should be added. The time for drenching should be thirty to forty-five minutes in

a paddle vat; in a still vat, one to three hours with two or three thorough agitations during that period; in a drum twenty to thirty minutes is sufficient.

The water should be preferably 75 degrees to 90 degrees Fahr., if cooler than this, more salt will be required to keep down the plumpness. Several packs of skins may be put through this drench, with a fresh addition of 15 pounds of lactic acid for each succeeding pack, adding the acid, 5 pounds at first, and then ten pounds after the goods have been in fifteen minutes. If skins are too plump, 10 pounds of salt may be added with succeeding packs, but it usually is not necessary. For dried slats the above quantities may be decreased one-third.

Goatskins.—After the skins have been bated with manure, prepare a bath in a paddle with warm water and for every 100 pounds of skins add one-half to three-quarters of a pound of lactic acid and an equal quantity of salt. Water should be at 90 degrees Fahr. before the skins are put in; they are paddled twenty minutes, then washed off and pickled. This method is advantageous for goods that are intended to be colored as the lactic acid cleanses them in the best possible manner.

Horsehides, Coltskins, Cowhides, Etc.—Use one pound of lactic acid and one pound of common salt for every 100 pounds of hides for first pack, adding the acid in two portions. For succeeding packs add three-quarters of a pound lactic acid and one-half pound of salt for every 100 pounds of hides. This drench may be used for a week or so, but the addition of salt should cease after five or six packs have been put in. The temperature of the drench should be 85 degrees Fahr.; time consumed from thirty minutes to four hours, depending on the weight of the hides and the agitation they receive. The more thoroughly they are washed after liming the less acid they require. After the process is completed they should be rinsed in warm water and then pickled or tanned.

Heavy Upper and Patent Leathers.—For heavy upper leather made from hides such as wax grain, buffed, mat or boarded

leathers and for patent leather, or when thickness and weight of splits are the main considerations, the simplest method of bating with lactic acid is the best. An excess of acid is used. This removes the lime and holds the hide plump. The formula for such cases is one pound of lactic acid for every one hundred pounds of hides, green weight. Bating is done in a paddle or still vat for four or five hours or over night. This bate may be used continuously for a week in warm weather, or for two or three weeks in cold weather, with a fresh addition of three-quarters pound of lactic acid to each hundred pounds of hides for each new pack put in. The water in the bate should be at the ordinary temperature. By this method good grain and fine heavy leather are obtained.

In those cases where an extra fine grain is desired, as for glove grain and calf leathers, a more depleting bate must be employed. In starting such a bate an addition of common salt is usually made in proportion of one pound of salt to one hundred pounds of hides, and then the lactic acid is added in several portions. The total amount of lactic acid should amount to about three-quarters of a pound for one hundred pounds of hides. As an example: For a pack of hides weighing 2000 pounds, the amount of lactic acid to use would be 15 pounds. The bate would be made up by putting in first 20 pounds of salt and 5 pounds of acid, and then the hides are introduced. At the end of an hour an addition of 5 pounds of lactic acid should be made and at the end of another hour 5 pounds more of lactic acid should be added. This bate may be used a week or more until foul, adding the lactic acid in 5 pound proportions each time for each new pack; four or five hours should suffice for bating. There need be no fresh quantity of salt put in as the lactate of lime which will accumulate in the bate answers the same purpose. Instead of running away all of the bate liquor after it has been used a week or so, it is generally advisable to use part of the old bate for starting a new one by running it into another bating vat, and then filling up with fresh water. The bottom half of the old bate may be allowed to run away as it will contain too much accumulated matter.

In cold weather the bating for heavy upper leather should be warmed somewhat, say to about 75 to 80 degrees Fahr. as the most desirable temperature.

In most cases, instead of using an absolutely new bate, it is advantageous to mellow the new bate by adding part of an old bate to it.

An example may make this method clearer: There are, we will suppose, two bating vats, A and B. In the beginning one of these (vat A) must be started fresh. After vat A has run a week, vat B is started by filling it half full of water and adding the right proportion of lactic acid, and then pumping the upper half of vat A into it. The bottom half of vat A is then run off. At the end of the second week A is half filled with water, and the upper half of vat B is pumped in, while the lower half of vat B is run off. Thus two vats are worked alternately, and always with a fairly old bate liquor.

Hides should always be bated four or five hours, or over night, at from 60 to 90 degrees Fahr. Skins should be bated one to three hours at 75 to 95 degrees Fahr.

To a certain extent, the procedure with lactic acid differs little whether the hides or skins are to be vegetable or chrome tanned or whether (if vegetable tanned) the material be bark alone, or extract alone, or a mixture of the two. However, the amount of lactic acid to use, and the time of bating, must always depend somewhat on what is to be the subsequent treatment of the leather, as it does also on what has been the previous treatment, that is, on the liming, whether lime alone, lime and sulphide, or sulphide alone has been used. With skins and green split hides other varying conditions are also introduced. The principle involved, however, is in all cases the same; sufficient lactic acid must be used to neutralize and remove all the lime, and sufficient time must be allowed for this reaction to take place. A slight excess of acid and cold water is used when a plumping effect is desired, and when a depleting effect is wanted less lactic acid is employed, in warmer water, and older lactic acid bate, or a certain proportion of

common salt is added. Generally speaking, for skins and green split cowhides which are to be chrome-tanned, the depleting effect is more desirable, and for heavy hides which are to be bark-tanned the plumping effect. The general proportion of lactic acid to use is one pound for every one hundred pounds of hides, green weight. It is generally better, especially for hides, not to keep them continually agitated, but only sufficiently so to give the liquor proper circulation and free access to all the stock. The lactic acid bate gives heavy splits and firm, fine-grained leather. In tanning liquors lactic acid gently plumps the stock. In the retanning of splits it quickens the penetration and thus shortens the time for retanning. By reason of its diffusibility, it acts uniformly throughout the hides, causing whatever swelling it may effect to be evenly distributed, thus preventing wrinkles and pipey grain.

TO DYE CHINA GOATSKINS BLACK.

Chinese goatskins are imported into the United States and England tanned and made up into rugs. The process of dyeing such rugs black is an English process, and is carried out in the following manner: The quantities of dyeing materials are for sixty rugs which are really equivalent to one hundred and twenty skins. In a vat of about three hundred and sixty gallons capacity, make up a bath of twenty-four pounds concentrated ammonia and thirty-six pounds of common soda, previously dissolved. When these have been added to the water heat up to 95 degrees Fahr., immerse the rugs for two hours, stirring at intervals. Then pull them up and let them drain well.

Dissolve fifty pounds dark turmeric; boil forty-five pounds logwood extract and add them to the bath. Throw the rugs in and leave them in the liquor until they rise to the surface. Then haul them out and add twenty-five pounds logwood extract, ten pounds sumac, ten pounds bluestone (sulphate of copper) five pounds fustic extract, and three pailfuls or about sixty pounds acetate of iron; stir up well and immerse the rugs

for eighteen hours, draw them up and expose them to the air for twelve hours. Then heat liquor up to the above-mentioned temperature and put the skins back for twelve hours more; draw them out of the liquor, hang them in the air for a time, and they are then ready to be washed.

They should be very thoroughly washed with plenty of clean water until all dirt and superfluous dyestuff are removed; then wring them and tack them out to dry. When almost dry, put them into a drum with a mixture of silver sand and mahogany dust and run them for about four hours, after which they should be put into an open slat wheel or cage and be run for two hours to clean out the sand and dust and to finish them off. The latter process, if carried out properly, will be found to give an added brilliancy to the fur which cannot be obtained in any other way.

BATING WITH MOLASSES.

Sour molasses makes an effective bate for hides for heavy leather. The molasses is soured by putting seven gallons of it into a barrellful of water, adding a gallon of milk to help the souring, keeping the mixture at 90 degrees Fahr., and stirring occasionally until it is sour. More than one barrel is required so that more molasses can be souring while the first is being used.

To use the sour molasses, fill a paddle wheel with enough water to cover fifty sides, and add to it eight pailfuls of the molasses. The sides remain in the bate at least thirty minutes and a few minutes longer will do no harm although there is always danger of bating too low. Judgment must be used as to when the hides are bated enough. When the bate becomes weakened by the lime which works out of the hides, more sour molasses should be added, say six pailfuls to 200 sides. If the paddle holds fifty sides put in one and one-half pailfuls of molasses after taking out each pack of hides, and keep the temperature of the bate at about 80 degrees Fahr. The bate should not be made fresh for each lot of hides but molasses

should be added to it. When the bating is over, withdraw the hides and rinse them in cold water in another paddle wheel for a few minutes, and after this has been done put them on sticks for the tanning liquors. The bated hides will contain considerable lime, but the first few hours in the liquor will take it all out.

After the liquor has been run through the yard from the head handlers to the tail handlers or rockers, the liquor in the tail handlers will be very weak, containing less than one per cent. of tannic acid, and quite a little lactic and acetic acids, which soon takes the lime out of the sides and plumps them.

A little lactic acid, say three-quarters or a gallon to the prepared bate liquor, will help considerably in effecting a removal of the lime from the hides.

BATING WITH DERMIFORMA.

Dermiforma is a prepared bacterial bate that has been introduced as a substitute for dung in bating. The methods of using described below have proved satisfactory, and the result desired has been obtained.

It should be borne in mind that bacteria are governed by different temperatures, and if it is desired to reduce or deplete the skins or hides the temperature of the bating liquor should be kept as near as possible to 95 degrees Fahr. during the process.

Experience has shown that a different grain is obtained at different temperatures; consequently if the liquor is kept at the above mentioned heat as nearly as possible during the process the skins will be reduced more quickly and the grain will be finer. This applies to all classes of stock. The quantity of Dermiforma to be used for every hundred pounds of skins varies.

In the bating of goatskins four pounds are used for each one hundred pounds of them to be bated; the same quantity is used in bating calfskins; but sheepskins may be bated with two pounds to each one hundred pounds of them; and the same quantity bates hides and kips, while seal skins require three pounds of the bate for one hundred pounds of them.

It usually requires about four hours to get calf, seal and sheepskins in condition to be pickled or tanned. It requires good judgment of the operator to know the exact time for the bating process; consequently no general rule can be laid down, as some tanners do not bate hides longer than two hours at a temperature of 95 degrees Fahr. If it is desired to plump the stock, one and one-half pounds of the bate will be sufficient for one hundred pounds; time generally from two to four hours, and in some cases where hides are being plumped for sole leather they can remain in the bate over night. The temperature should be normal or not over 80 degrees Fahr.

In using *Dermiforma* in tanning liquors, either sweet or natural sour liquors, one and one-half pounds to every one hundred pounds of green hides will plump them, and the leather will gain in weight. Where extract liquors are used entirely the result is greater and the tannage more rapid with the above proportions. In all cases the hides must be thoroughly washed from the limes or the proportions given will not answer. When excess of free lime is carried into the bating process more bate is required. It is said that, with the above proportions, *Dermiforma* will completely delime hides and skins more quickly than any other process known.

Bating should always be done in a vat with paddles and not in a stationary tub, as the action of the paddles causes the liquor to be agitated, thus more quickly accomplishing the deliming and neutralizing of the skins. A warm bate depletes or reduces the goods; a cold bate plumps them. When deliming is complete and the skins are soft and silky to the touch they should be removed from the bath, rinsed in warm water or not, according to their condition, and then be either pickled or tanned. Skins are most satisfactorily bated in warm liquor while for hides for heavy leather, in which plumpness and weight are essential, a moderately cold bate is best.

THE BRAN DRENCH.

Any tanner who wants to use a bran drench upon his skins

will find the following process satisfactory: Add enough water to a half barrelful of bran to make it mushy; cover it up and let it stand forty-eight hours, or until it has become thoroughly sour. This quantity of bran is sufficient for from four hundred to five hundred skins, according to their size and thickness. The sour bran is emptied into a suitable vat half filled with water and having a paddle-wheel. Three pints of sulphuric acid and three pecks of common salt are then added and the mixture is plunged and heated to 90 degrees Fahr. Throw the skins in as quickly as possible and keep the paddle running for four hours or longer until the goods are soft, clean and well drenched. Light, thin skins of course require less drenching than thick, heavy ones. If they are to be colored, it is advisable to work the grain out as clean as possible, and then to rinse them in warm water and pickle them. For black leather the working out can be omitted, they being simply rinsed and pickled. The drench can also be prepared by using the following proportions: Soak fifty pounds of bran in warm water until sour. Then stir the mass into seven hundred gallons of water in a paddle vat and add ten pounds of sulphuric acid. Plunge the drench thoroughly, warm it to 90 degrees Fahr., throw the skins in, and bate them until they are soft and clean and free from lime. Then work the grain out as clean as possible, rinse the skins, and pickle them. Either of these processes will drench them in a safe and satisfactory manner.

A third method of preparing a bran drench is as follows: Two hundred pounds of bran are used for six hundred or more skins. The temperature of the bath should be about 90 degrees Fahr. One-half of the bran is put into the water and stirred well. Then one-half of the skins are put in, having previously lain a few hours in warm water, and the liquor is thoroughly stirred. The balance of the bran is next put in and then the remaining skins. The bran ferments; and to this fermentation is due the deliming of the skins. The length of time consumed by the process depends upon the amount of lime in the skins and upon the development of the drench. This last method is less safe than either the first or second.

BATING WITH DOG DUNG.

If dog manure be kept for some time, it will become heated of itself, burn up and become useless. Consequently it is placed in barrels, covered over with enough water to soften it, and then allowed to ferment for at least two weeks, or until it has resolved itself into a pasty condition. It can in this way be kept for months in covered barrels without losing any of its bating action.

When it is to be used, it is stirred into boiling hot water (by this means a great many of the bacteria are killed but not the spores) until after decanting off several times all of the soluble matter has been removed and only waste material remains behind. But all sand must be allowed to settle out again from the liquor, since if any is allowed to remain, it is likely to injure the grain; this settling takes place to the best advantage in a large vat.

For 100 pieces of calfskins it is customary to reckon about 10 to 12 quarts of dog dung; while for 30 dozen sheepskins about 50 pounds of manure are used; and for 1000 pieces of young lambskins from 10 to 12 liters of the diluted infusion are sufficient. The proper amount of the bate is placed in the paddle wheel and diluted with the necessary quantity of water. At the beginning, the temperature of the bating liquor should be between 20° and 35° C. (68° to 95° Fahr.) according to the kind of skins and the season of the year. The pelts should remain in the bate for from two to three hours, or at the most until the flesh remaining on them can be readily removed. It is injurious to bate the skins for too long a time.

After bating with dung, it is best to rinse off the skins and then at once place them on the beam or fleshing machine. By placing them in fresh water, on the other hand, the flesh becomes tender and is not removed as readily as when it is in the mellow condition in which it comes from the bate; consequently as little water as possible is used so that as little as possible of the mellowness is lost.

In the process of dung bating it is easily possible that unde-

sirable fermentations take place which are injurious to the skins. The duration of the bating in a normal case should occupy a definite time which is regulated by the temperature, concentration and texture of the hides as well as by the degree of fermentation which the bate has experienced.—Joseph Jettmar.

BATING WITH A COMBINATION BATE.

Dog manure and bran used together make a better bate than either material used alone, but such a combination bate requires careful preparation, exact proportions to be maintained, and close attention while the skins are being bated. For soft stock one part of manure and two parts of bran are used; for hard goods, equal parts of each. The dry manure is stirred into cold water, and after adding the bran, the mixture is allowed to ferment thoroughly, which takes only a few hours. It is then strained, and after adding a few ounces of bicarbonate of soda dissolved in water, it is stirred into warm water in a vat and the skins are bated in the liquor. The use of this bate saves time and material and accomplishes thorough bating. It is an old process and has been superseded by cleaner and safer methods.

If the skins are to be tanned with bark it is best to allow the fermentation to take place in a warm liquid. One part manure and ten parts bran start the fermentation. The bran is mixed with warm water, and the manure is stirred into the mush. The mixture may be allowed to stand until it is fermented, or it may be diluted with warm water in the vat and the skins placed at once in it. Another way is to make an infusion of the dung and mix it with fermented bran. This bate is a compromise between a manure and a bran bate. The quantity of manure required is reduced from one-half to one-third of the usual amount; there is less odor and less danger of the bad effects which frequently result from ordinary manure bating.

PROCESS FOR MAKING GRAIN LEATHER FROM SPLITS.

The splits should be run through a borax bath in a drum.

Five pounds of borax dissolved will be enough for twenty-five splits, medium size and weight. Have water, six gallons, heated to 75 degrees Fahr., and run twenty-five minutes. Then make a bath of sulphuric acid, say about eight gallons, and have it as sour as a lemon. Drum the splits in this for fifteen minutes, then rinse them off in clear cold water. Run in plenty of clear cold water until the acid is all soaked out of the splits, and then fat-liquor them.

To fat-liquor the splits use any good soap and oil fat-liquor that is suitable for vegetable-tanned leather, and run them in it thirty minutes. Then horse them up to drain, after which slick hard on both sides, and glass on split side. Oil with linseed oil; than hang them up or tack out to dry. When dry, they are ready to be colored black or brown or any other color that is wanted. After they are colored and dry, they are ready for the moss or linseed solution. A good dressing is made from equal parts glue and gelatine. Apply when warm but be sure and not have it too thick. Care should be taken to spread it on evenly. The dressing is then allowed to dry; and the splits are now ready to be embossed either in imitation of some grain, or plain. This is a very necessary operation, and the machine used for the purpose is from four to six feet in width.

After embossing, the embossed side is given a coat of water-proof filling which is made of wax and rosin dissolved in turpentine, and the splits are then done.

TO DYE COLORED LEATHER BLACK.

The following process is said to be a good method of re-dyeing leather that has been colored and the tanner wants to re-finish into black. Put the leather into a mill and run it in warm water for at least one-half hour to remove the finish and to prepare it to receive the dye. Now, for each dozen skins of medium size or eight small sides dissolve four to eight ounces of permanganate of potash crystals in six gallons of warm water and drum the leather in the solution fifteen minutes;

then dissolve from twelve ounces to one pound of logwood crystals in ten gallons of hot water and add this solution to the potash solution and skins in the drum, and run the drum one-half hour. Now dissolve one ounce of copperas and blue vitriol and cool; then pour this solution into the drum and drum ten minutes. Next wash the leather in clear running water for at least fifteen minutes. The leather is now ready to be set out and dried. It must always be thoroughly washed, and the grain should be liberally oiled with a mixture of paraffine and cod or neatsfoot oils before it is dried out.

PRACTICAL DRUM PROCESS FOR VEGETABLE-TANNED SKINS.

This process is based on a long known principle, viz., a preliminary tanning with alum and salt as a preparation for tanning with vegetable tanning material. But the manipulation of the process as here described is new, as is also the further treatment after the introductory work, by means of which various drawbacks hitherto present in combined tannage are eliminated and certain advantages gained.

The process is as follows: The skins are limed, bated and drenched in the regular manner and then put into a weak liquor of bark or extract and left therein until they have assumed a fine and uniform color. It is best to suspend them in the liquor until they are colored. They are then thoroughly washed in a drum, then given the preliminary tanning, also in the drum, drumming being continued for one hour. This preliminary tanning is done with alum and salt. For each hundred pounds of skins ten pounds of alum, six pounds of common salt and eight gallons of water are used. After drumming, the skins are allowed to remain in the solution for a few hours, when they are rinsed with clean water and neutralized by being placed in a bath made up in the proportion of two pounds of borax in twenty gallons of water for one hundred pounds of them. In this solution of borax they are washed in a drum fifteen minutes; they are then washed in clear water and are next placed smoothly over horses to drain over night when

they are in condition for the tanning proper, which is effected in a drum. The liquor can be made up of any suitable extract or a mixture of extracts, such as quebracho, quermos, hemlock and gambier, or combinations of quebracho and hemlock, or of quebracho and palmetto, or of oak and hemlock extracts. As, by reason of the preliminary treatment, no shrinkage of the grain is to be feared, the liquor may be comparatively strong. The first liquor may be $1\frac{1}{2}$ to 2 degrees Baumé, increased afterwards to 3 degrees. Strengthening of the liquors must be done quickly, since the tannin is rapidly absorbed. The complete tanning is generally finished within a few hours. When the skins are tanned, they are washed, split and shaved as they may require, and are then dried, or fat-liquored and dried, and finally colored and finished in the usual ways. Some tannages are improved by a retanning in warm sumac liquor as soon as the tanning proper is finished. A liquor made up of two-thirds quebracho and one-third hemlock extracts is recommended for this process. The advantages of this method of drum tanning are as follows: The preliminary tanning causes a certain amount of swelling, and the skins to become more absorbent. The grain gains in resisting power through the contracting effect of the vegetable tan liquor, so that the pores remain open and the tanning material penetrates more rapidly. The internal condition of the skins produced by the preliminary tanning favors the action of the drumming, which causes the strong liquor to penetrate again and again into every part. This advantage is still further increased in this method by treating the skins in a weak vegetable tan liquor previous to the alum bath, which also sets the grain and removes the last traces of lime from the goods as well as tending to a finer color and smoother grain.

Sulphate of alumina may be used in place of alum with the same result. By removing the alumina from the skins every trace of acid or soluble salt is eliminated and all the advantages of the preliminary tanning are secured without incurring the disadvantages that result from it not being removed. When

alum and salt remain in the skins free acid is formed in the tan liquor which acts injuriously on the substance of the leather. This method of tanning consists in neutralizing the skins after tanning with alum or sulphate of alumina which largely eliminates the fault mentioned. But even if the acid is made harmless the salt remains, which causes deterioration in the quality of the leather and makes it loose and less waterproof than is desirable. By removing the salts completely and washing and neutralizing the skins so that every trace of acid and soluble salt is removed they are brought into perfect condition for tanning with vegetable tanning liquor and for making firm yet soft and durable leather. By first treating skins with alum and salt subsequent tanning is hastened, but, as has been pointed out, the alum and salt should be neutralized and washed away if the best quality of leather is to result from the drum tanning with extracts.

THE DONGOLA PROCESS.

The dongola process consists of gambier, alum and salt. It can be used in tanning skins or heavy hides, and it makes soft, plump, well tanned leather. A good dongola liquor is made in the following manner: In one hundred gallons of water forty pounds of alum and thirty pounds of salt are dissolved by boiling. One hundred and eighty pounds of gambier are boiled in two hundred and fifty gallons of water until dissolved, and the alum and salt solution and the gambier liquor are mixed together in a vat or tub. By the addition of one hundred gallons of water and one quart of sulphuric acid a good, strong dongola liquor is made.

Hides or skins may be tanned in this liquor and made into very desirable leather. When the stock is fully tanned, it is washed and pressed, and then given some oil or fat-liquor in a drum. Three gallons of neatsfoot oil or the same quantity of cod oil cut with borax may be used for three hundred pounds of leather. Sulphonated oil may also be employed or any suitable fat-liquor. When the leather is dry it may be damp-

ened and colored, or dyed black and finished in dull or glaze. A gambier liquor of about four degrees barkometer strength is prepared and to it are added ten pounds of salt and six pounds of alum for every one hundred gallons. This liquor should be strengthened each day until the skins are well tanned, which can be easily ascertained by the tanner.

The process can also be used as a two-bath process by starting the tanning in a liquor of gambier, alum and salt and finishing in a straight gambier liquor. The hides or skins are limed and bated and are then pickled with sulphuric acid and salt, after which they are placed in the tan liquor. A gambier liquor of about six degrees strength is prepared and to it are added ten pounds of alum and seven pounds of salt to each one hundred gallons of liquor. Hides should remain in this liquor three days, it being strengthened every day; they are then drained and split. Skins remain in the liquor less time than hides according to their thickness.

The second liquor should be a straight gambier solution. The tanner must use his judgment in determining the strength of this liquor. For hides it may be 18 or 20 degrees barkometer and they should remain in it three days, when they are drained, fat-liquored with oil and hung up to dry. When dry they are stuffed with oil and degreas, blacked on the grain, dried and finished.

Light skins may be fat-liquored with oil and soap or with sulphonated oil, dried, grain-blackened, and finished. They can also be treated with oil immediately after tanning, dried and colored, and then fat-liquored with a regular fat-liquor, dried again, and then finished.

Tanning can also be done by drumming the skins in an alum and salt solution and then tanning them with gambier.

Light skins can be tanned into soft dongola leather by being tanned in a liquor of gambier, alum and salt and then fat-liquored with a fat-liquor containing flour and egg yolk. This makes excellent glove leather. The skins, if they have been pickled with acid and salt, should be neutralized and then

washed in warm salt water before they are tanned. Tanning can also be done with gambier liquor containing flour, egg yolk and a little neatsfoot oil. No fat-liquoring is then necessary. Or the tanning can be done with gambier, alum and salt, and the skins subsequently fat-liquored with sulphonated oil, dried, and colored.

A process of tanning hides in a dongola or combination tannage is described in *Schuh and Leder* in the following words: The beamhouse work is conducted similarly to other upper leathers, and is generally hurried as much as possible with arsenic. After the hides have been bated and washed they are pickled with sulphuric acid and salt. A medium sized paddle wheel is filled half full of water; twenty pounds of sulphuric acid and seventy-five pounds of common salt are added, and the whole is set in motion a short time to properly mix. The given quantity is sufficient for 1,000 pounds of stock. The hides or skins are run in this liquor three hours and then allowed to drain for a few hours.

Tanning is now commenced and is accomplished as follows:

For 1,000 pounds of hides or skins, sixty pounds of gambier, sixty pounds of palmetto extract and fifty pounds of quebracho extract are dissolved in sufficient water to make a rather thin liquor. In a separate vessel twenty-five pounds of chrome alum and thirty-five pounds of salt are dissolved, and the whole arranged so as to produce forty pailfuls of liquor. Tanning is effected in the paddle wheel, and if a fresh liquor is used five pounds of sulphuric acid must first be added, then five pailfuls of the extract each morning and evening. On the fourth day the first part of the tanning is ended. Good results are also obtained by hanging the hides in the liquor. After the first part of the tannage the leather is washed, then pressed and split and shaved.

For the retannage which now follows, six pailfuls of strong liquor are given for each one hundred pounds of split leather and the latter is run in the wheel from two to three hours, then washed and pressed again, but this time only to a certain de-

gree. If it is pressed too dry it will absorb too much grease, and if it is left too wet sufficient grease cannot enter. For one hundred pounds of pressed leather fifteen to eighteen pounds of grease must be figured. For stuffing, seven pounds of moellon degreas, four pounds of tallow and five pounds of paraffin oil are recommended, and in this mixture the leather is run one-half hour. After the stock has been dried it is soaked again and then set out on both the grain and flesh sides. The leather is then dampened in sawdust and staked. A good blacking is applied and the finishing is done to suit. The writer would add that doubtless any good fat-liquor can be applied to the leather, and after a retanning with sumac, colored leather can be made by applying the proper dye.

THE USE OF BORAX IN THE TANNERY.

Borax was used by the Egyptians in tanning their bright colored leather with both vegetable and mineral tannins. It was also used by the Romans in leather manufacture. The utility of borax in the manufacture of leather has long been recognized, and it is now to a great extent supplanting soda in all its forms in the modern methods of the tannery and currying shop. It is not only economical but effective in producing the very highest class of goods, imparting to leather a smooth, silklike finish.

Tanners are learning that there is no one material, ingredient or chemical that possesses so much all-round usefulness for them as borax. It has wholesome, sweetening and disinfectant properties, and in the prevention of formation of bacterial organisms it is of use in the process of soaking. One of the first things to be considered is the quality of the water. In addition to hardness, many waters, while apparently pure, are infected with microbes, ferments and germs of both vegetable and animal origin to such an extent as to render them entirely unfit for soaking purposes without the addition of some good antiseptic.

For this purpose borax is of value. It is safe, pure and in-

expensive. When used in soaking dry hides, borax cleanses the dirt from the hair, softens up the grease which has dried on the grain and forces the water into the body of the hide more quickly than salt or any other known substance. In the soaking and cleaning of green salted hides before liming it has no equal.

Borax not only prevents the formation of chalk of lime, but by its use the grain of the hide or skin is made soft and silky allowing the hair and scurf to be readily removed. By its use in the rinse water, a large amount of lime is removed, and the green stock needs then but little drenching to remove the remaining lime. Borax in the rinse water and boracic acid for a drench make a combination that insures an even run of raw hide, that will produce leather of soft, mellow grain, with full bellies and flanks, and that will not pipe.

Frequently, in using soft water for rinsing hides or skins, the addition of borax proves beneficial, since soft waters are often charged with carbolic acid, which in a great measure produces the same effect on the grain as when a limed skin is exposed to the air. In the manufacture of upper leather, as well as in that of sole or rough leather, reducing in a drench made from borax is best for cleansing the hide from sulphide of sodium and lime. Borax is useful in the soaks to all tanners of wool and fur skins. It not only cleanses the wool and fur and softens the skin itself, but it also prevents the slipping of the hair in spots. Some of the costly fur skins are of an extremely oily nature and heretofore many have been lost or damaged in the soaking. By the use of borax this is prevented. It cuts the grease, removes the blood and lymph, and turns the skins out in a clean and healthy condition. By its use many a skin is being saved that otherwise would be lost. It can be used just as successfully in the preparation of wool skins for the pulling process. Too much cannot be said in favor of washing chrome-tanned leather with borax to free it from acid. If the stock is not properly washed there is trouble all around. Strong alkalies make the leather hard and rubbery, and cause difficulty in the dyeing, in putting

out and all through the finishing room. Bicarbonate of soda is used for the purpose, and it frequently happens that the neutralization is uneven or the process is carried too far. Borax is as safe and sure a neutralizing material as is known. It removes the acid and leaves the grain soft and silky and open for the coloring and seasoning processes. In the dye bath it gives a lively color on any class of goods, and stops any running of the dye, and on account of its making a color fast it is taken advantage of by manufacturers of shoe dressings.

In bleaching chrome-tanned stock, borax will not disturb the tannage, but it thoroughly removes the acid and leaves the stock in a full, smooth condition, and of a nice white tint that does not discolor when exposed to the air.

The bleaching properties of borax are being taken advantage of in the shoe factory for preventing water stains and for bleaching soles. By using a small amount of it in the water for wetting the sole, the surface is opened, allowing the water to penetrate evenly and a clear uniformly colored bottom is produced. The sole is made flexible and chipping of the edges is prevented. Another important point is that the soles are put into condition to readily absorb stains.

In addition to the various uses that have been named, borax is employed in the preparation of fat-liquors and logwood liquors. The latter produces the best result when it is slightly alkaline; and to make it so nothing is better than borax.

TANNING WITH PALMETTO EXTRACT.

Palmetto extract may be employed in tanning many different kinds of leather, either alone and in combination with other extracts, but it is chiefly used in the manufacture of soft leathers and in retanning. The principal characteristics of palmetto extract are great penetrability and desirable color. It produces soft, tough, pliable leather of good weight and color like oak. The advantages of palmetto extract over gambier are that it tans more quickly, gives greater weight, plumper leather, stands a higher temperature in stuffing and varnishing, and in a few

hours produces from raw skins leather that is tough and quite waterproof. It is good to use in drum tanning; it tans ordinary skins in a few hours. It is also useful in combination with chrome tanning, neutralizing the acid, causing the leather to take grease better and acting as a mordant for black and aniline coloring, and also making the grain less rough and loose than any other chrome combination tannage. When palmetto extract is used the leather is smooth and takes a nice color. For black leather, it is a good mordant, the color being improved in consequence of it. Some tanners of chrome leather give their stock a treatment with vegetable extract in dilute form before blacking; palmetto extract is excellent for this purpose.

Good results are obtained from the use of palmetto extract in the retanning of splits tanned with hemlock, quebracho, oak, etc. Combined with quebracho extract, it makes fine upper leather. Any tanner who knows how to tan with gambier, hemlock or quebracho will have no trouble in using palmetto extract.

From the chemical point of view, palmetto extract is not as high in percentage of tannin as some other extracts, yet those who have used it claim that it contains more available tannin to its tannin content than any other material. On account of its natural mineral properties, palmetto, in extract form, possesses great fluidity, and in the drum tannage, where best results are obtained, it can be used the full strength of 30 degrees Beaumé. The hides or skins take up the non-tannin as well as the tannin, so that there is no waste of material whatever. With palmetto extract calfskins can be tanned in from three to six hours, and other skins in a correspondingly short time. Sides split out of lime can be tanned in four or five hours, depending upon how thick they are.

Palmetto extract is made from the roots of the saw palmetto (*Sabal serrulata*) which grows abundantly along the eastern coast of Florida and in fact all over the entire state. The extract contains on an average 22 per cent. organic tanning ma-

terial and 6 per cent. inorganic or mineral tannage, or in all about 28 per cent. of that active principle which combines with raw hide to make leather. The roots of the saw palmetto, which range in size from four to six inches in diameter, contain 8.3 per cent. tannin. They grow horizontally, mostly on the surface of the ground, and are easily dug, and can be had for the getting, the owners of the land being glad to have it cleared. The roots are cut into four foot lengths, measured the same as cordwood, put through a bark cutting machine, then leached the same as oak and hemlock bark. The resulting liquor is concentrated in vacuo to extract of 50 degrees Twaddle, when the product is ready for the tanner.

Palmetto, unlike oak and hemlock bark, can be gathered the year around, and the tannic acid strength seems to be uniform, the season for gathering making no difference.

Besides its usefulness in tanning upper leathers, palmetto extract could be used to good advantage in the first stages of tanning sole leather, especially for union crop, or for any leather where a light color is required. For, when employed in the first stages of tanning to set the color, although heavy hemlock liquors may be used afterward that would naturally make the leather very dark, the light palmetto color will reappear after a light bleach or wash is used, and give the leather a fine, light shade.

Tough, durable harness, line, belt and strap leathers can be made with palmetto extract. The work of preparing the hides is the same as for any other tanning process. Lime and sulphide of sodium are used for about five days, then the hides are unhaired by machine and fine-haired by hand. They are next bated and washed, then tanned. They go into tan liquor for six days in a section of liquor beginning with 12 degrees barkometer and ending with 20 degrees. Too many of them should not be put into the weakest liquor or they will color unevenly. From the weak liquors where they were suspended on sticks the hides are put into full strength palmetto liquor 30 degrees B \acute{e} . (50 degrees Twaddle). They should be handled twice the first day

so that the tanning material may fasten evenly. After six days the leather is tanned through; it is then aired, shaved and split. After shaving it is put into weak palmetto liquor, 12 degrees barkometer, and finished in a 30 degree liquor, being wheeled for six hours or until thoroughly tanned. In order to keep the color light and the grain tender the leather is fat-liquored with soap and degreas, then dried out. Harness and belt leathers are stuffed with stearine at 140 degrees Fahr., after they are dried out from the fat-liquor. This process makes plump leather of good grain and color, tough and durable. For 440 pounds of pressed leather, the fat-liquor referred to is made of five pounds of fat-liquor soap and nine pints of moellon degreas in one-half barrel full of water, steamed to 120 degrees Fahr.

A good way to tan calfskins and the grains of split hides is to lime and bate them as for gambier, chrome or combination tannage, then to put them into a 3 or 4 degree barkometer liquor, increasing this to 7 or 8 degrees. Then keep increasing the strength of the liquor by doubling until the leather is tanned through. It may then be put away in sour liquor for six days to swell, when it is washed, pressed, shaved, fat-liquored with soap and degreas, and dried. When dry, it can be colored and finished in any desired manner.

In drum tanning the skins are started in cold 8 degree barkometer liquor, reeled in a vat half an hour, then put into the drum with 30 degree liquor, or 450 pounds of extract for 700 pounds of them at a temperature of 80 degrees Fahr. At the end of six hours the leather is pressed, split, shaved, and retanned in the drum. It is now washed, pressed and fat-liquored, struck out and hung up to dry, when it is ready to be dyed or colored and finished in any desired manner. Retanning with sumac is beneficial for colored leather.

To retan chrome leather with palmetto extract, one gallon of it and one pint of glycerine are used for one hundred pounds of wet stock. The leather is drummed in the liquor, of which there should be twelve gallons, for twenty minutes, then drained and colored with aniline dye.

TANNING WITH CHESTNUT EXTRACT.

Chestnut extract, prepared with care, is practically a pure solution of chestnut wood tannin, rich in tanning power per unit of density and soluble to a high degree. It will form liquors free from sediment or liquor-fifth, well balanced in tannin and non-tannin for oak and hemlock yards, and fitted for the business of tanning hide-fiber with thoroughness and celerity.

The successful use of chestnut extract, as well as that of any other process capable of various applications is based upon general principles which may be briefly stated thus: Chestnut extract is midway between oak and hemlock in souring qualities; hence it acts beneficially in both yards. The hemlock tanner fighting for acid in his sour end, gets it by chestnut admixture; the oak tanner combating excess sour in his handlers controls conditions by chestnut in his head liquors.

Chestnut extract should for color reasons be well incorporated with the leach liquors. Its natural color is brown, which the extract manufacturer modifies towards red by treatment. Mix as much as 75 per cent. with the head leach liquors, and the bark color will dominate. Tan the stock in chestnut alone and the color will be "on the brown." This is the secret, and the only secret, regarding color in the use of chestnut extract. Put it on the head leach (through the sprinklers, or a little at a time as the leach fills with bark), and take down the liquors in the time-honored manner, making the draw of the desired barkometer average. As the yard becomes saturated with the chestnut, several things will be observed—the packs will feed more rapidly, they will "stand up" higher, and the plumpness put into the stock in the sours will hold up to the rolling room. This is because the liquors sent to the stock are richer in tannin per unit of barkometer, without an increase of the liquor-fifth which impedes entrance of the tannin into the fiber of the stock. Leather is made in the beamhouse and the sour end of the yard; most anything can be done to it if proper beam treatment and plumpness are parts of its record, so long

as it is fed. After the handler period is past, the stock should enter the heavier liquors in the state of plumpness and grain wanted in the finished state, and from that point forward it should be struck steadily and persistently, with such frequent shifting as will keep the feeding process continuous.

The function of chestnut extract is thus made clear: It is a tanning agent pure and simple, with souring properties halfway between hemlock and oak, aiding the handlers in one, and restraining them in the other. No other extract possesses this unique feature. The amount of combined tannin which can be put into a hide depends almost wholly upon the degree in which the initial plumpness is retained during the passage of the stock through the true tanning liquors, those beyond the handlers. If these liquors are clean, and grade up from 20 degrees barkometer in the first layer to 50 to 60 degrees in the last, the combining process will proceed uniformly and steadily, flanks will be full and firm, the cut will show as much color from the one side as the other, and the "white streak" will be firm and plump. Such leather has good market qualities, and also has more room for finishing material and a larger area of hide-fiber to take the tannin. Chestnut extract promotes exactly these conditions, with, at the same time, a beneficial effect on the sour end of the yard.

There are various ways of using this extract. By some it is put directly on the leaches, and there allowed to dissolve and percolate through the ground bark. The chief advantage claimed for this is that the disagreeable bluish-gray color on the stock is avoided. Other tanners dissolve the extract in a separate tank and then run it on the leaches through the sprinklers. Some prefer to dissolve the extract separately, then mixing the solution with bark liquors as they come from the leach house. These methods, however, are not the latest nor the most approved ones, practical experiments having proved that chestnut extract is most successfully used along other lines, which may be described as follows:

The hides are first soaked and then washed in a paddle.

wheel. After unhairing, they are well worked on the grain, then left hanging over night in the old water pool, to which a certain quantity of commercial lactic acid has been added. For ordinary packs forty pounds will be sufficient. As they are thus plumped, and the fixed lime being also neutralized, the ordinary time in the handlers may, with safety, be materially reduced. Coming from the cold water pool, they should again be washed on the grain before going to the liquors. The green pack is given a week in the handlers, which are soured to the proper degree by the addition of lactic acid. The hides go from the handlers through the first two layers, after which they are run through a roller press and are then ready for the drumming process.

The extract is poured into hot water, and the solution run on the stock through the gudgeon at about 16 degrees barkometer. At first the drum is revolved slowly. The two essentials at this stage of the process are the maintenance of the liquor strength and keeping the stock comparatively cool. After running until the hides become warm, they should be withdrawn for a sufficient time to cool. During this interval the old drum liquors are run to the handlers and new liquor is supplied to the drums.

After the leather is thoroughly tanned, weight is given by putting it in a drum with a certain amount of undissolved extract and then run long enough to have it take up the extract. It is then finished the same as usual. One of the advantages of the drum system is that entirely sweet liquors can thus be given to the stock, since the natural resistance of the fiber to the penetrating power of the tannin is overcome by the attendant agitation. However, it can readily be seen that the old drum liquors sent to the handlers will not contain a sufficient amount of free acids, other than tannin, requisite for the holding of the proper plumpness of the hides; hence it is necessary to add lactic acid to the handlers in order that the proper relations of the acids may be maintained. As there is an absence of natural lactic acid, best results will be obtained

by adding the commercial article to the head handler liquor in the proportion of one pound of lactic acid to every one hundred pounds of hides, green weight. Besides adding to the head handler liquor, it is advisable to add lactic acid to the other handlers half way down the series, in amounts growing smaller from the head liquor.

Chestnut extract is a valuable tanning material for the tanner of heavy leather. Its tannin is so easily available that it is one of the most acceptable on the market. Light skins, prepared as for any other tannage, may be tanned by suspension in chestnut liquor or drummed in liquor made direct from the extract or a mixture of two extracts. Skins intended to be colored subsequent to tanning are usually tanned direct in the extract liquor, with occasionally a re-tan in sumac. Stock to be run in the natural color is usually struck in the mixture, giving the shade desired. With very thin leathers the main requirement of the tanning material is that it shall be clean, bright and quick in action. Light hides for side leathers are first put through a series of sour liquors, in which they are plumped. The liquors are prepared by direct solution of the extract in water or freshly-made bark liquor; thus prepared they are given sweet to the nearly struck goods, usually as lay-aways, not infrequently in revolving drums. These stocks are always tanned out in relatively weak liquors, rarely exceeding 15 degrees barkometer, as freshly prepared. Tanning is then completed in drums. Where a particular color quality is desired the leather is retanned with suitable material, such as palmetto, gambier, mimosa, quebracho, sumac, etc., according to the shade or color condition sought.

TANNING WITH QUEBRACHO EXTRACT.

Quebracho extract is at present used by many classes of tanners, by those of sheepskins as well as by those of sole and other heavy leathers.

On calfskins, sheepskins and upper leather, quebracho extract is an admirable substitute for the higher priced gambier,

producing fine grain, soft texture and firm feel. On patent leather it gives a pliability which prevents cracking after the varnish is put on. On bag and strap leather it makes the light color that is necessary for dyeing with aniline colors. On harness and belting stock it produces the tensile strength and toughness which are necessary, and it enables the leather to carry all the grease required. On sole leather it decreases the time necessary for giving good gains, and makes more mellow stock than a straight bark tannage. In fact some sole leather tanners are using quebracho to give them extra weight, for experience seems to have demonstrated that, owing to its peculiar concentration, it will penetrate hides already well tanned.

The quebracho tree grows in the central part of the Argentine Republic, and is one of the hardest woods known. It is most difficult to cut, and derives its name ("Quebrar"—to break—"ache"—an axe) from the fact that the best axes go to pieces in cutting down the trees. The trees are of extremely slow growth, and logs such as are shipped to the United States and Europe for purposes of making extract are often a thousand years old. The heaviest machinery is required for cutting this wood up into a form suitable for extraction, and owing to its great weight the handling of quebracho logs, which often weigh two or three tons each, is both difficult and dangerous. The bark of the tree is useless for tanning purposes, and, together with the sap-wood, is removed before the logs are ready for shipment.

The extract made from the wood of the quebracho tree is different from all other known tanning extracts, chiefly in the fact that it will not turn sour. In addition to this it is a comparatively clean extract, that is to say, it contains a higher percentage of tan to a given density than any other of the well known extracts. Inasmuch as it has little or no tendency to fermentation, quebracho is extremely useful for controlling the acid in tan yards that tend to go sour. On the other hand, if it is used in yards where considerable acid is needed, care must be taken to prevent the sweetening up of the liquors by the use

of too much of it. This is obviated by the use of artificial acid or, as in Europe, by the employment of other tannins which contain a large proportion of other materials.

Quebracho, being a sweet tan, is not itself a plumper, and if used on leather which has not been properly plumped is apt to quickly tan the outside of the hides and thereby prevent the penetration of the tan to the inside. This results in cracky leather not properly filled. If, however, hides are plumped before going into quebracho liquor, this material will penetrate, fill and produce tough, pliable stock of light color.

A very important point to be observed in using quebracho extract is, that it should be dissolved properly. Solid extract needs to be boiled up in hot water, in a tub containing a false screen bottom which prevents it from adhering to a solid surface. The liquid extract should be dissolved in water standing at 180 degrees Fahr. The resulting solutions from both grades of extract, should then be stirred well and allowed to cool down gradually before being used. It is a great mistake to run hot quebracho liquor into cold vat liquors, or in fact to suddenly chill any extract liquor. Such sediment as remains in the cooling tub may be worked up with fresh water on a tail leach or elsewhere.

A great deal depends upon the proper dissolving of quebracho in its successful use in the vats, and it is far better that such precipitation as takes place should go on in the cooling tub rather than on the leather.

The use of the Barkometer.—The barkometer underrates the strength of tannin in quebracho when compared to the strength of ordinary bark liquors. This is owing to the fact that the quebracho wood contains very much less material which forces up a barkometer than does bark. A pure quebracho liquor, for instance, made up from nothing but quebracho extract and water is, at 20 degrees barkometer, fully as strong in tan as a sweet bark liquor of about 30 degrees barkometer. This variation in the barkometer value must be taken into consideration, or else the tanner is apt to get the quebracho liquor too strong and burn the fiber of the leather.

Quebracho, being sweet, tends to make pliable, rather than hard, leather, the latter resulting more or less from sour liquors. On heavy leathers, such as harness and belting, it is extremely useful on account of the toughness which it gives to them.

It is being used with success on upper leathers for a fore-tannage, and also for retanning splits coming therefrom. On patent leather it is particularly useful on account of the pliable qualities which it gives to stock that is to receive a coating of varnish.

Quebracho produces leather of an oak shade, with a very slight pinkish tendency. Leather tanned with this material, however, should not be dried in the sun, as the color becomes red on exposure to the light.

Hides that are intended for quebracho liquors should be very thoroughly cleansed from lime, that is to say, properly bated, since quebracho and lime do not go at all well together. Bark liquors act more or less as a bate all the way through, but quebracho, with its peculiar sweetness, does not do so, and on coming into contact with lime in the hide fiber produces bad grain and bad color.

Quebracho is useful in the tanning of heavy leathers in strengthening the head liquors, and in keeping them sweet. It penetrates very quickly and by its use tanners are often enabled to increase the weight of their leather. The best results are obtained by mixing quebracho extract with other tanning materials, such as oak and hemlock in the tanning of heavy leathers. The process of tanning is quickened by the use of quebracho, and the cost of tanning is somewhat cheapened. It is useful in making sole leather as well as upper and harness.

TANNING SNAKE SKINS.

Tanning with Alum and Salt.—Snake skins, like all other skins, should be soaked in water until they are soft, then broken or fleshed on the beam, and put back into the water for a few hours. They are then put into a solution of sulphuric acid and salt to pickle them, after which they are brought into a solu-

tion of equal parts of alum and salt, in which they remain over night or longer. They are next hung up to dry; and when dry, are run with moist saw dust until all the scales are off; they are then staked carefully, dried and finished.

Tanning with Bark or Extract—Snake skins can be tanned in bark or extract liquor the same as calf and sheepskins, beginning with weak liquor, handling often and increasing the strength daily. While soaking, they should be worked by hand until they are soft and flexible and the outer scales removed. When soft, and the scales have been removed, they are in condition to be tanned; the tanned skin is soft and flexible and the natural colors are but little changed.

Tanning with Salt, Alum and Gambier.—A writer in the Leather Manufacturer describes a method of tanning snake skins in the following words:

“The method is about the same as for any skin. Assuming that the skin is either green salted or dry salted, then soak in the usual way. Flesh, wash and put into the lime vat for four or five days until the outer scale can be easily removed. Afterward wash and give it a bran drench until properly depleted; wash, and pickle with a salt and alum liquor for three days, one part alum, two parts salt with sufficient water to cover. After pickling, start to tan in a 5 per cent. gambier liquor which may be daily increased until it has reached 10 per cent. The skin will be tanned in from six to fourteen days, according to its size and thickness. After tanning, oil or fat-liquor, dry out, wet down, shave, sumac, again oil or fat-liquor if required; stretch out and tack, drying slowly. When dry, grind the flesh off with sand-paper block or block of pumice, and finish as wanted, either dull or bright. If the latter, casein or shellac; if the former flaxseed gum or gum tragacanth.

HOW TO TAN DEERSKINS.

Deerskins may be tanned with oil, with sumac, with alum, salt and egg yolk, in a chrome process, and with gambier, alum and salt. These skins are generally wanted very soft; thorough

and long liming is therefore necessary. They are soaked and fleshed, then painted with a mixture of lime and sulphide of sodium. As soon as the hair becomes loosened it is removed, and the skins are put into lime and limed about twice as long as sheepskins; the grain is then removed and the skins are drenched and tanned. When an alum, salt and gambier tannage is to be used the grain is left on, as the skins are used for moccasins, soft shoes and slippers. For oil tannage the grain is removed after the skins have been limed.

Oil Tannage.—After the grain has been removed the skins are drenched and freed of all lime. They are then treated with oil in the same manner as sheepskin fleshers for chamois leather. When fully tanned they may be used in the natural yellow color of the process or colored the same as chamois skins.

Another way to tan the skins consists of drying them after liming and without bating; then soaking them back and giving them an oil tannage. Tanning is effected in stocks which pound and turn the skins until they are tanned, which takes several days. They are then washed in warm soda-ash solution to free them from the thickened oil. From this oil that is removed, by the use of an acid, sod oil is recovered. French degreas is recovered by dipping the skins in hot water and then pressing them under a hydraulic press. Coloring is accomplished in the same manner as described for chamois skins.

Sumac Tannage.—The skins are limed and drenched in the same manner as other leathers; they are then tanned with sumac, after which they are washed, put out hard on flesh and grain-oiled, especially on the flesh side, which, being porous, rapidly absorbs the oil. The quantity of oil to be used depends upon the condition of the skin, and must be determined by the judgment of the tanner. The skins are next hung up and dried and the grain is then buffed, the skins being staked and softened and the flesh run on an emery wheel. Alum and sumac also produces well tanned skins.

Alum Tannage.—In this process the skins are tanned with

alum salt and egg yolk, as described for mocha castor glove leather, and also for white alum tanned sheepskins.

Gambier, Alum and Salt Tannage.—A light yellow colored leather is obtained by tanning deerskins with gambier, alum and salt, and then smoking them with smoke from dry birch wood. The skins are limed and drenched in a bran drench and then tanned, being handled and stirred until they are fully tanned. They are then hung in a smoke-house and thoroughly saturated with the smoke from dry birch wood, with the object of coloring them. The process requires skill and attention to get a uniform and satisfactory color. After they have been smoked they are smoothed on the flesh side on an emery wheel, stuffed by hand with a mixture of the best cod oil, tallow and stearine, set out on the grain and hung up to dry. Staking, perching and sometimes boarding complete the process. The skins can also be colored dark oxblood and brown, and when finished are very attractive leather. The leather tanned this way makes soft and durable shoes and slippers that are especially suitable for nurses' wear, sporting shoes and moccasins.

Indian Tan.—The following method is said to be the way the American Indians tanned deerskins: Take a skin either green or well soaked and flesh it with a dull knife. Spread it on a smooth log and grain it by scraping with a sharp instrument; rub nearly dry over the oval end of a board held upright. Take the brains of a deer or a calf, dry them gently by the fire; put them into a cloth and boil until soft; then cool off the liquid until it is lukewarm with water sufficient to soak the skin in, and soak the latter until it is quite soft and pliable. Wring it out as dry as possible, wash it in soap suds and rub it dry, then smoke it well with wood smoke. Instead of brains, oil or lard may be used, the skins being soaked therein six hours.

Chrome Tannage.—Deerskins can be made into very soft and tough leather by being tanned in a chrome process, and fatliquored, and colored the same as any other chrome leather. The method of preparing them for tanning, the process of tan-

ning, and the coloring and fat-liquoring, are the same as for sheepskins. By applying to them the instructions given for sheepskins, splendid leather can be made. Shades of brown and tan can be obtained; and when finished the leather will be very soft, tough and strong. The skins should be limed a day or two longer than sheepskins; otherwise the treatment is the same.

GRADING AND CLASSIFICATION OF GREEN CALFSKIN.

Green calfskins are graded and classified as follows by one of the largest calfskin dealers in this country. They are first graded as to qualities, viz.:

First, drawn or fisted off.—These are skins that are perfect in every respect, fresh, clean, free from scars and other imperfections and in choice condition. No deep scars are allowed on the bodies, although slight knife marks are permissible. If the hair slips on a spot no larger than a silver quarter dollar, the skin drops down into a No. 2.

Second, regular No. 1.—These are clean fresh skins that have been properly taken off with knives. Scars are allowed in this grade, but there must be no holes, hair slips or other bad imperfections. An old salt-stained skin, even though it has no holes nor hair slips, is not allowed in this grade, but is put into No. 2.

Third, good No. 2.—This term designates those skins that are slightly hair slipped. In this grade are also included those that have one, but not more than one, hole in them, and all old or salt-stained skins, even though they have neither holes nor hair slips.

Fourth, proof No. 2. This class of skins are those that have more than one and less than five holes in them; also those that are badly hair slipped or otherwise badly injured.

Fifth, culls.—A cull is a skin that has five or more holes in its body, or one badly damaged by reason of moths, ticks, taint, or other serious imperfections.

There is another still lower grade, which is called *glues*.

These skins are practically worthless for tanning into leather, and are always bought on terms agreed upon by buyer and seller. After the skins are graded according to quality, they are subdivided to weights, viz.:

First, what are known as deacon or dairy skins. These have been taken from calves whose meat is not used for food. They weigh in the green, in an untrimmed condition, less than seven and one-half pounds. This classification also includes trimmed veal skins weighing under five pounds.

Second, five to seven pound trimmed veal skins. This classification also includes a deacon or dairy skin weighing, green and untrimmed, seven and one half pounds and more.

Third, seven to nine pound veal skins.

Fourth, nine to twelve pound veal skins.

Fifth, twelve to seventeen pound veal kips.

Sixth, kips weighing from seventeen pounds up.

These are the grades and classifications into which the skins are sorted when they are received at the warehouse of the dealer, and they are sold in these grades to tanners, although all dealers do not strictly follow these classifications. When skins are carefully graded as to quality and weight, and the characteristics of each grade are well known to the tanner, he can buy the class that is especially adapted to his particular needs.

Slunks are skins taken from still-born calves. They are very light and tender, and have a very fine, clear grain. They are usually sold at a certain price per skin, the price being determined by the quality.

Large numbers of calfskins are imported into the United States from foreign countries in both green-salted and dry condition. They are used for the same purposes as domestic skins, the green-salted ones being made into chrome, patent and other leathers while many of the dried stock, owing to damaged grain, is valueless for leather finished upon the grain and must be made into wax and other similar leathers. Dry skins from Russia, having thick and long hair, are used in the manufacture of coats and robes.

THE MANUFACTURE OF SEAL SKINS.

Raw seal skins come to the tanner in a freshly salted condition, and are broadly speaking, divided into two classes: "small" or "white-coat" seal, "large" or "cow seal."

The "small" or "white-coat" seals are principally used for making levant grain, and "large" or "cow seals" for making walrus grain, though a grain similar to the latter is frequently produced on the small seal and likewise the levant grain on cow seals. As the processes differ somewhat in order to obtain these different grains, it is necessary to describe them separately. Before doing so it is well to say a word concerning the water to be used and the effect it has upon the resultant leather. A very soft water produces poor, soft, hungry leather, the grain being soft and of poor formation, while a very hard water produces solid, tight leather and the grain is flat and difficult to work up. Experience has taught that a moderately hard water produces the best results and is most suitable for tanning seal skin.

Levant Grain. The skins, when taken from the barrels in which they are shipped to the tanner, are found to be covered with salt crystals and are very greasy. A convenient pack of about twenty-five dozen is transferred to the soak pits. The water in the pit must not be absolutely cold, and in winter time it is necessary to warm it up a few degrees.

After remaining in soak for a day, the pack is hauled up and fleshed over a beam. As much as possible of the loose blubber and grease is removed by the beamsmen. The skins are then put into a fresh soak and remain in it forty-eight hours, when they are again scraped over the beam, this time on both flesh and hair sides.

It will be found owing to the very greasy nature of seals, that the beamsmen have difficulty in handling their knives, but this is readily overcome by occasionally using a handful of sawdust and rubbing their hands with it.

The skins are now ready for liming. White lime alone should be used, as it has been found to produce the best results.

Sodium sulphide in conjunction with lime produces a "pipey" grain. Arsenic and lime produce a soft and silky grain.

For the ordinary sized pit, a half barrel of lime is slaked in the usual manner, and when filled up with water, is thoroughly plunged, so that the lime is well diffused throughout. Two men are required to put the pack in the pit, one to throw each skin in separately and the second to push it down with a stick so that it will lie evenly. The time required for liming varies according to the weather. In winter twenty-one days are enough; in summer not more than sixteen days are required. Every other day the skins should be hauled up and the lime plunged. When the first pack has gone through, the second pack should follow into the pit, but it should remain in it only twenty-four hours, when the lime is run off and a new one substituted. Owing to the extremely greasy nature of seal skins, it is necessary to give them this long liming. In order to produce a firm leather with the requisite hard grain, it is necessary to keep the limes as fresh as possible. If the limes are allowed to become old and strong their action upon the skins is such as to produce tender leather with a soft grain.

Unhairing.—The skins are unhaired on the beam; though unhairing machines have been used, it is questionable whether they are any cheaper in the end. Care must be taken to rid the skins of the young hair, which is sometimes found difficult to remove.

After unhairing, the superfluous lime is removed by washing the pack in a wheel which is constructed so that the water can be kept running in and off while in rotation. It will be found that the water running off will be milky in appearance, gradually getting clearer, and when quite clear the washing is completed and the skins are ready for puering. Dog's dung is used, but good results have been obtained with Dennis' Puerine. The dung should have previously been soaked so as to start the action of the bacteria. To a paddle, two or three pailfuls are required; and the water in the paddle should be warm enough to bear the hand in it comfortably. The time

required depends upon the temperature of the puer, whether the paddle is closed or open, and the strength of the dung. No set rule can be given but must be gained by experience. However, the skins are to be brought down fairly low; and a good guide to determine when they are low enough is to occasionally take one out and pinch it between the forefinger and thumb. When a decided impression is left on the grain, the puering has gone far enough. From two to six hours should bring them down, though the larger seal require longer treatment and can stand a stronger infusion of dung.

The skins are washed in lukewarm water for a few minutes and are scudded over a beam. Slate knives are usually used for this, which is rather an important operation, as it removes any free lime or lime salts that may be in the skins.

A bran drench should (previously to scudding) have been made by scalding half a bag of bran and a pailful of pea meal in a pit or paddle. After the scudding of each skin, it should be immediately thrown into the drench. If a pit is used, the skins may remain in it over night; if in a paddle only five or six hours are required. They are then washed through water and are ready for tanning.

In this country the materials found to efficiently take the place of oak bark and sumac, as used in England, are quebracho extract and sumac.

Tanning.—A cube of solid quebracho extract is dissolved in a barrel by boiling. This constitutes a stock solution. A ten degree barkometer solution of this extract is taken and drummed together with the skins in a closed wheel for one hour, sufficient liquor being used so as to cover the goods. This sets the grain. The skins are then put into a paddle containing about a twelve-degree liquor, and remain in it until they are tanned. The strength of the liquor is gradually increased. Tanning should be complete in a week, which can be tested by cutting off a small piece and observing whether the tan liquor has entirely penetrated the middle of the skin, leaving no white streaks. When tanned the skins are drummed

in a wheel with one-half bagful of sumac and a few pailfuls of liquor for two or three hours. They are then struck out on a machine and hung up to dry.

When quite dry they are taken down and struck out, either by hand or by machine, using good hot water to soak them in; then they are hung up to partially dry out. Such edges as are dried out should be redampened with a sponge before resetting them on a table. After this resetting they are ready for blackening. Two piles, a dozen skins in each pile, are laid on the table with the necks and butts running one way, and are dyed with the following materials:

Blackening.—A pailful of good, strong logwood solution, to which a half cup of ammonia has been added, is heated up to boiling point and applied to the skins with a brush or sheep-skin pad. This is immediately followed by a solution of iron liquor and glue, prepared by pouring a gallon of iron liquor over one-half pound of best glue; this is allowed to stand a few hours and heated up before use. This *floss*, as it is commonly called, is put on the skins evenly and thinly, care being taken to rub it in thoroughly. The skins are laid face to face after blackening, covered up and allowed to remain over night to allow the black to set.

They are then grained from angle to angle with a board covered with a piece of thin tin perforated similar to a nutmeg grater. After these two "cuts" they receive another "cut" on the belly with a cork-board, followed by a "cut" straight up the skin. Dried in a hot room, afterwards "emeried" and flesh side and seasoned with the following: Three-fourths pailful of water, one quart albumen (blood), one pint milk, one quart ink. This is applied with a sponge, and skins are laid face to face until they come to or are dry enough to be glazed. After glazing they are sprung up with a cork-board.

Walrus Grain Seal.—The large sealskins usually used for this kind of work are soaked in the above-described manner. In liming them, however, a pound or two (according to the size of the pack) of sodium sulphide is used in conjunction with

lime. From ten to sixteen days is enough liming for this class of work.

When unhaired the skins are thoroughly washed in water. They are not bated with dog's dung, but put into a strong, old bran bate and brought down in it. They are taken out and drummed in a hot and fairly strong liquor, which contracts the grain, thus forming the well known walrus grain. The subsequent tanning is done in a paddle, and when tanned the skins are hung up, dried, blackened, grained and seasoned.

TANNING AND DRESSING SEAL SKINS FOR LEATHER WORK.

The seal skins used for leather work are quite distinct from the fur-bearing varieties, and are all members of the family *Phocidæ*, they being generally captured off the coasts of Newfoundland, Labrador, Greenland, Nova Scotia and the shores of New England. The Newfoundland fishery is the largest by far, and furnishes work for a small army of men in Scotland and the former country. Seal leather is used for enameling, although much of it is dyed for fancy purposes, book-binding, etc. Handsome as it is, it has, however, been largely supplanted by imitations made from embossed skivers and goat skins, large quantities being worked up in Germany.

Soaking and Beamhouse Work.—Seal skins are soaked for three or four days in changes of water according to condition; they should, of course, be hauled up each day to drain, and at the end of the soak the "blubbering" should be done thoroughly. This is still done over the tanner's beam with a sharp fleshing knife, the object being to remove as much of the adhering fat as possible.

In passing on to the limes care should be taken to see that the skins are not in a putrid condition, which would cause loss of substance. They should be placed at first in a weak and old lime, and gradually worked into stronger limes, finally being finished off in a new lime of medium strength. They are naturally very greasy, and will stand from three to four weeks liming to neutralize the grease, although a great deal depends upon their condition and the temperature.

When the skins are sufficiently limed, they are unhaired and fleshed in the usual way, and are well-washed in tepid water and passed on to the splitter. First, allow them to drain well over a horse, taking care they are well covered, and that the edges do not become dry, or signs of lime blast will be seen on the finished leather.

Splitting.—Splitting is now usually done on the belt-knife machine, which in capable hands does excellent work. The substance, of course, will vary according to the requirements of the market. The grain usually goes for patent or enamelling purposes, although it is often used for bookbinding and fancy leather goods. Too thin middle splits and one rough split can usually be got from each skin, and the “linings” are then usually thrown back into the limes for a couple of days to get rid of as much of the grease as possible. About a couple of days is usually sufficient for this with one handling. The linings are then washed in tepid water, slightly acidified with acetic acid to neutralize any resisting temporary hardness.

Bating, Scudding and Drenching.—In spite of chemical substitutes, deliming is best effected in the old-fashioned dog puer, care being taken to keep the temperature at about 104 degrees Fah., at which it is safe and effective. This process should be placed in the hands of an experienced and capable man. If the skins are spoiled here no amount of attention will rectify mistakes. When sufficiently down, they should be scudded, every care being taken to remove as much grease, scud and filth as possible.

At this point it is usual to drench the split seal skins to remove all traces of pigment and lime salts. The drench is prepared by scalding enough bran at about ten degrees below boiling point. This is cooled down to 95 degrees Fah., when the skins are entered. If the drench ferments properly, the skins will rise to the top as the gas generates; they should be pushed down until the drenching has been carried far enough, when the goods are slated out of warm water, ready for tanning.

Tanning Process.—Seal skins should be struck through by running them first in a paddle with a weak gambier and sumac liquor of about 10 degrees barkometer. Care must be taken to insure a sufficiency of acidity, otherwise the skins will fall, and will remain flat and papery when finished. After running in this weak liquid for about six hours, pass on to next paddle, making up liquor with gambier to about 20 degrees barkometer.

It is as well to add about a quart of acetic acid to carry five dozen grains or linings. In this paddle the time taken should amount to about seven hours. The third liquor should be made up to a strength of 35 degrees barkometer, and about the same amount of acid should be added to it in proportion. It will also help to fill out and improve the goods, if about a pailful of oak wood extract is added to the liquor after they have been running in it for half an hour. If this has been properly carried out, the skins will have been struck through and should be horsed up and allowed to drain ready for sumacing.

This is best done in a vat, although a paddle is sometimes used. The bath is prepared by adding water at about 50 degrees C. (122 degrees Fahr.), to about a quarter of a hundredweight of best Palermo sumac. Experience has shown that more tannin is extracted at this temperature than at a higher one. Cool down before entering the goods at 30 degrees C. (86 degrees Fahr.), and haul up once or twice, warming the liquor each time. After laying in the sumac over night the skins should be horsed up and, after draining, taken to the sheds for drying. Care should be taken not to expose them to the strong or harsh winds in the early stages, and the use of steam or artificial heat should as much as possible be avoided.

Tanning the Splits.—The splits may be treated and tanned as follows: Enter into a liquor made up to 35 or 40 degrees barkometer, with best oakwood extract and sufficient water. For every five dozen splits add two quarts of acetic acid, which will help to maintain the goods in a plump condition. Keep the splits (linings) in this for two days, handling once. Horse

up to drain and dry out steadily. Experience has shown that the best quality of tanning materials is the cheapest. Cube gambier, for instance, costs more than the block, but is richer in tannin and does not contain the dross common to the former article. Above all, use the best Sicilian sumac; better by far to give a few dollars more per hundredweight for the best ventilated article than to haggle for price with a dealer, and then perhaps get a low grade sumac badly doped with lentiscus.

Directions for Finishing.—When the grains are brought down from the shed, they are treated, where weight is a consideration, as follows: For every ten dozen skins take twenty-eight pounds of chloride of barium, and with sufficient water to wet them, work the goods in a drum, together with six gallons of sumac for an hour at 104 degrees Fahr. From this they are plunged, a dozen at a time, into a weak solution of sulphuric acid; this should taste moderately acid when applied to the tongue.

Stir the skins for three or four minutes until in fact they assume a whitish appearance. The chemical action causes the barium chloride to be changed into barium sulphate. After each dozen skins is taken out of the bath, sufficient acid should be added to keep it up to the required acidity.

The skins are now ready for hoisting up and striking out, the latter being done on the grain side in the ordinary way, and the grain side is wiped over with best linseed oil. They are then hung up to sammy or stiffen sufficient for setting. When ready, let them lay in piles, after dampening down all dry parts, for a day or two, and then set out long ways, and after that from neck to butt. Now hang them up and allow them to dry out. When dry, break down with graining board, pushing the goods up on the flesh side from neck to butt, and turning and doing the same on the grain side. Fluffing or buffing follows. This should be effected on a fine emery wheel, and done cross-ways, commencing at the butt, going about half across, turning round, and reversing. Now draw the skins straight down on the grain.

Treatment for Split Linings.—The linings, after being dried

out, may be weighted by drawing them through a strong solution of chloride of barium, as above described, but they must be drawn through the acid bath one at a time if tearing is to be avoided. Now wash with warm water, and lightly strike out with a suitable ridging board. They are then ready for straining, and when dry are buffed on one side and enameled on the other. They may also be utilized for colors by soaking in warm water, and running them through a weak acid bath, and drying in a paddle at about 113 degrees Fahr. If acid dye is used the goods can be dyed at once, but if basic dye is used the tannin should be fixed by tartar emetic.

After dyeing to shade, wash in cold water, run out with the ridging board and tack out or strain, taking care that the goods are not dried too rapidly. Moderate heat, or a weather dry is preferable, as the goods fall off the tacking boards when dry if they are not carefully watched. When dry, they are taken off the frames, and the side that is to be faced is filled up with a potato-flour paste, made by adding sufficient of the farina to water to form a stiff paste. When the paste is cold add a little color and apply a good coat of it, after which the goods are again tacked on the straining frames or boards. When dry, they are seasoned with an albumen seasoning made by soaking six ounces of albumen in cold water over night, and making up to two gallons with a pint of milk. Apply the seasoning lightly with a soft sponge; hang the goods up until in condition for glazing, and glaze with a suitable machine for the final finishing.

The splits, after being struck out and tacked, are stripped from the straining frames and then rolled to flatten down the rough surface. They are next stained, which may be done as follows: Into a pailful of boiling water holding about three gallons dissolve three ounces of dye, stirring until dissolved. Now strain the dye liquor through cheese cloth doubled over a few times. A mixture of one of the fast browns and yellows will, after an experiment or two on a small scale, produce the shade required. While the three gallons of dye are hot, add to them about six ounces of dissolved starch. This will slightly thicken

the dye, which even with this addition will penetrate very rapidly, and consequently should be spread quickly and evenly with a suitable brush.

Finishing Operations.—Finishing this class of goods is a simple matter once the proper receipt for the finish is obtained. The following has been found to work very well in practice if brushed on carefully and the linings hung up until nearly dry, *i. e.*, in the proper condition for rolling: Boil for an hour or so two pounds of Irish moss and four pints of flaxseed in a steam-jacket pan. Then add one pound of gelatine which has been soaked over night in a little water and a half pound of curd soap. The boiling should be carried on long enough to extract all the mucilage in the flaxseed and moss, and at the end of the time the mixture should be well squeezed through a fine-meshed bag. After the seasoning is applied cold, or nearly so, the splits are well rolled under the jack, and after trimming are ready for the warehouse table, eventually finding use for shoe linings, valises and other articles.

Splits for White Shoes.—For sporting and athletic shoes, seal splits are frequently sold as a good imitation for the real deer-skin article. These goods are treated as before described so far as soaking, liming, bating and drenching are concerned. Only the best and stoutest splits are selected for this purpose.

After drenching, the splits are washed in warm water and placed in a pickle made as follows: For every hundred-weight of pelt, cook until dissolved twenty pounds of alum and fourteen pounds of salt. Put the goods into the mill and add the pickle in instalments while they are in motion. Care must be taken that the temperature of the pickle does not exceed 95 degrees Fahr. The pickling operation should take about one hour, when a mixture made as follows should be added: Mix thirty-five pounds of flour with enough hot water at 95 degrees Fahr. to form a stiffish paste, and add half a gallon of egg yolk and about five pounds of china clay. No oil or grease is necessary, as seal splits are naturally of a greasy nature.

To apply this dressing it is best to stop the mill and to add

about half the paste to the goods; mill for a quarter of an hour, then stop and add the remainder, milling again at least for two hours. Now take the splits from the mill, double them across and spread them out in a vat or tub. The liquor left from the mill is then poured over them and they are allowed to lay in this for three days, hauling up once a day and allowing to drain. After the final draining tack on frames or boards and dry quickly. If this is not done the result will be poor, as the alum and salt will hardly get a chance of being fixed properly, and the finished leather will be tinny and flat.

The splits are now allowed to lay in a cool place for two or three weeks to feed and mellow, and they are then staked. Damp down first by draining through the liquor they laid in, after making up to a convenient quantity with water. Lay them in a pile until they are in good condition for staking. The staking is best done in the old-fashioned way by hand, although it is possible to do good work by machinery under suitable conditions. The splits are then dried and worked out on the perch with the old arm-crutch stake. Now carefully run them on the emery wheel, using fine emery. Commence at the butt and work about half-way across, and then turn them and do the other side in the same way. Now turn over and repeat the operation as before, and a fine, velvety fiber will be the result. After being again placed in the perch, rubbed over with whitening and finally worked out well with the hand-scouring tool, the splits are ready for the shoe manufacturer.

RAPID TANNING PROCESS FOR SOLE LEATHER.

It is of primary importance to thoroughly remove the salt of salted hides, and to soak them well. During the process the water should be frequently replaced by a fresh supply. This work is best done by hanging the hides on sticks into the vats. They are then placed in weak limes strengthened with sulphide of sodium and left therein, the liquor being gradually strengthened until they can be easily unhaired. They are then unhaired, bated lightly and washed clean.

They are next placed in the tannage, which may be commenced with oak liquor, to which some mimosa or myrabolans has been added. The density of the liquor should be about 1 degree Bé. at the beginning and raised gradually to 3 degrees Bé. The hides are transferred to stronger liquor daily, and before they are put into the drum the tannage must strike through well. This condition will appear at the end of about two or three weeks, according to the thickness of the hides. Next the drum is prepared. The liquor is taken from the 3 degree Bé. vat and poured into the drum. Into a separate layer tank 350 pounds chestnut wood extract, 350 pounds quebracho wood extract and 300 pounds oakwood extract are dissolved. Of this liquor enough is taken to strengthen the first liquor to 6 degrees Bé. Care must be taken to have more liquor in the drum than one foot under the shaft. Now the hides are thrown into the drum; after two hours the extract is improved until the liquor reaches 8 degrees Bé. During the drum tannage the strength of the liquor should never be allowed to sink below that given, and under no conditions below 8 degrees. In about forty-eight hours this drum tannage will be completed. The temperature must be kept down; and to prevent too much foam from forming, about one pint of turpentine is poured into the drum. It is an advantage to allow the drum to run day and night, and the revolution should not exceed eight or ten per minute. When tanned the leather is taken out of the drum and spread flat on the floor. In this condition it is allowed to remain one day, being well covered. After this time has passed the hides are placed in fresh water, into which a little tan liquor has been mixed. The density of this water should be about one-half degree Bé., and the time from one to two days. The liquor will strengthen itself to about 2 degrees Bé., and may be used to dissolve extract with or for any other tanning purpose. The tanned leather may also be immersed in a weak liquor made of that remaining from the first drumming. It may also be put into weak sumac liquor for some hours. The essential point is to remove the extract from the flesh and grain surfaces, leaving at

the same time as much of the weighty tan in the interior as possible. The leather is next thrown over a horse and allowed to drip. It is then oiled off on the grain and hung up to dry, with the heads hanging down. Strong draughts or sunlight should be prevented from coming in contact with it. When partly dry, it is set out by hand or on the machine. Before setting out, the following mixture is applied on the flesh side: In a pailful of water, six handfuls of gum tragacanth and three handfuls of talcum are mixed, and this mixture is put into a larger vessel into which enough water is added to make the whole six pailfuls. Next the leather is completely dried in a room having a good circulation of air. When completely dried it is laid on piles, then dampened with water and next rolled on the sole-leather roller.

Hides for drum tanning should be thoroughly delimed and perfectly colored, and set in the pit suspender liquors, which should be strong enough to neutralize all remaining lime. They are then put into a drum, and a used liquor of 10 to 12° Bé. may be employed; they are run in this ten hours, after which they are placed as before in a used liquor of 17 to 18° Bé. for ten hours. By this time they should be thoroughly struck through, and the tanning may then be completed in extract, giving enough to well tan them, and to show 17 to 18° Bé. for the following packs. The liquors get reduced very quickly, and will show a loss of at least 5° Bé. in the first two hours. The leather may now be put into a 4-degree liquor for two days, or into sumac liquor for several hours, and then be struck out on a machine, oiled with linseed or mineral oil and slowly sammied. When sufficiently sammied it is again struck out, lightly oiled and dried. If light and not required too firm, it should be rolled off with a heavy roller. If required firm, it should then be dampened and rolled. No drum-tanned leather should be rolled until it has first been thoroughly dried.

ONE-BATH CHROME PROCESS.

The following one-bath tannage produces excellent results

for glove leather and for chrome calf and side leathers. The best results are obtained by using a two-bath tannage first and this one-bath afterward, although good leather is made by using this process alone.

Formula for the Liquor.—Dissolve 54 pounds of chrome alum in 54 gallons of water at 70 degrees Fahr. In a separate vessel dissolve 6 pounds of Wyandotte Tanners' Alkali in 12 gallons of water at 100 degrees Fahr. Add this solution slowly to the chrome alum solution until the liquor begins to get cloudy. This shows that the chrome alum is nearly neutralized.

Pickle.—Prepare a solution using one pound of sulphuric acid with eight to ten pounds of common salt, 50 to 60 degrees barkometer. Pickle the stock thoroughly, then horse, grain to grain, for twenty-four hours. After draining, weigh the stock. Then neutralize it in a drum, using three pounds of Glauber's salt and twenty gallons of water for each five hundred pounds of pickled stock.

Tanning.—Put five hundred pounds of pickled skins into a drum. Use ten per cent. of the chrome liquor prepared as above in four equal parts. For example, use two and one-half per cent., four times, at intervals of twenty minutes. When all the liquor is in the drum run the skins in it for three hours. Then make a solution of seven and one-half ounces of Wyandotte Tanners' Alkali (or sixteen ounces of Wyandotte Tanners' Soda) and eight to ten gallons of cold water. Use this proportion for each one hundred pounds of leather and run for twenty minutes. Some tanners prefer to use Wyandotte Tanners' Soda in place of the alkali because it is more mild in its action.

HOW TO DYE COLORED CHROME SKINS BLACK.

By carrying out the following instructions colored chrome-tanned calfskins, goatskins, sheepskins and sides can be prepared for blacking and finishing into black leather:

Put one hundred and twenty-five calfskins or two hundred and fifty goatskins into a drum with warm water and run them

until they are thoroughly soaked, then drain the water off. Then take five pounds of Wyandotte Tanners' Soda and one hundred gallons of water and run for one-half hour, after which add one quart of ammonia and run for another half hour. If a paddle-wheel is used instead of a drum, take the same number of skins and the same proportion of soda to each five hundred gallons of water in the paddle; run an hour and then add a quart of ammonia and run another hour. It is advisable and better if the tanner has the time and a suitable place to allow the skins to remain in this solution over night. By using this process it will be found that the dye will penetrate much deeper and also give a very deep black. It will also be impossible to detect the fact that the skins were first fancy colors. Any suitable chrome blacking process may be used on the skins prepared as directed.

TARTAR EMETIC AND ANTIMONINE IN LEATHER DYEING.

Ever since the advent of tan and other colored leathers, tanners and leather dyers have experienced more or less difficulty in obtaining clear and uniform shades. It was thought when the chrome process of tanning was introduced that the chemicals which were contained in this tannage would have such an affinity for the aniline dyes that no mordants or setting agents would be necessary. Tanners soon discovered, however, that they could not make much progress in leather dyeing without using something that would combine with the tannin to form a mordant for the dye and to fix the color permanently on the leather. Antimony compounds, tartar emetic and antimonine, the latter a patented compound, have come into quite general use. By treatment with an antimony compound there is formed an antimony tannin lake which is less soluble than the simple tannate which is formed by the combination of tannic acid and dyestuff.

To obtain the best possible results, skins intended for colors should be selected with care, the texture and grain to be as perfect as possible. Skins tanned by a vegetable or a chrome

process should have a fresh bath of tannic acid before they are colored, that is, they should be treated with sumac or fustic extract.

As the sumac bath by itself fastens the tannin to the skin in an uncombined state, antimonine or tartar emetic is added to it. When uncombined tannin exists the colors are apt to be cloudy, whereas by the addition of antimonine, clear and uniform colors result, as the dye goes on evenly. Antimony and tannin form, as stated above, antimony-tannate, by which the tannin is combined with the antimony compound, so that when the dye solution is subsequently applied, mottled or cloudy coloring is avoided by the color going on evenly, the result being fast and uniform shades. The method of applying the process is as follows: For twelve dozen chrome-tanned sheep or goat-skins, use as a mordant three pounds of extract of sumac in water at a temperature of 95 degrees Fahr.; process the skins in a drum for twenty minutes, then add to the sumac bath one and one-half pounds of either antimonine or of tartar emetic dissolved in hot water and drum fifteen minutes longer. Then wash the skins in warm water by simply rinsing them, drain the liquor out of the drum, put the skins back into the drum and run them in the color bath. No bichromate of potash, alum or other material is required, as the antimonine or tartar emetic not only clears the grain of the skins but fixes the color as well.

Antimonine is a patented antimony compound, the number of the patent being 597107.

A NEW DEVELOPMENT IN CHROME TANNING.

The present development in the art of chrome tanning has been achieved, not by reason of the solution of the difficulties which were early encountered, but rather by avoiding the dangers which brought disaster, and which, as experience has taught, arose from a too close adherence to the older practice of tanning.

But the old order has changed and given place to the new to an extent little dreamed of but a few years ago, and the ques-

tion whether chrome-tanned leather is but a passing fad is open to discussion no longer.

New tricks have been learned and progress has resulted which has kept pace with modern demands.

Now that the solution of the early difficulties in chrome tanning is no longer vital or essential to the attainment of a satisfactory commercial product, nevertheless it is desirable that those difficulties should be examined and considered in the hope that their solution will, as it were, blaze a new trail to the desired goal of perfection.

The difficulty which caused more trouble, perhaps, than any other was due to the fact that any chrome-tanned leather would, if permitted to dry out immediately after tanning (the usual custom with vegetable-tanned leather), obstinately refuse to absorb moisture, in order that the process of dyeing and fat-liquoring could be proceeded with.

This then was the first lesson which experience taught in tanning chrome leather—that the tanned hide or skin had to be kept wet from the tan bath until fat-liquored, and failure to observe this rule was attended with disaster, so far as the production of good leather was concerned.

But before the operation of fat-liquoring could be proceeded with, the free mineral acids consequent to the fixation of chrome hydrate upon the fiber had first to be neutralized and the stock subjected to a thorough washing with water.

It was soon discovered that if this operation of neutralizing and washing took place too quickly after tanning, that is, before the chromium base had "fixed" itself on the fiber, a large portion of the tanning salts which otherwise would have become absorbed by the fiber were washed out, with the result that the leather subsequently had the appearance of being undertanned.

Consequently the usual practice has been to allow the goods to be placed in a pile on a "horse" several hours after tanning, and before neutralizing and washing.

It is apparent that the length of time during which the goods are "horsed," and the condition of the goods, must affect the

“fixation” of the chromium base on the fiber, and this in turn reflects itself on the quality of the leather.

In alum and vegetable tannages the drying out or “crusting” of the goods immediately after tanning is recognized as having a most important bearing on the quality of the finished leather.

Now if it were possible to “crust” chrome-tanned leather out of the tan bath exactly as alum or vegetable-tanned leathers are treated, it is clear that it must bring about a uniformity in the fixation of the chromium base which has not hitherto been attained, and because of this better absorption and fixation of the chromium base and its accompanying salts by the fiber, the quality of the leather is thereby considerably improved.

A process recently invented by the writer permits of chrome-tanned hides and skins being dried out after tanning, and may be allowed to remain in the “crust” condition as long as it is desired to do so.

The following is a description of the method employed:

The goods on being taken out of the tan bath are horsed up over night without being washed, and the next day are set out and shaved.

The wet or shaved weight of the stock is taken approximately. A bath is prepared in a drum with four pounds of standard lactic acid for every 100 pounds of wet leather, and sufficient water to diffuse the acid so that the liquor will come in contact with the goods immediately after they are thrown in and the drum revolves.

The goods are run in this bath for ten minutes, after which they are taken out and are immediately sent to the drying loft and allowed to dry out.

After drying the goods can be stored away until wanted, and can then be sorted into suitable grades and weights as required.

The dry leather when treated in the manner described absorbs water readily and assumes its original wet condition as it was when it came from the tan bath.

At this stage the leather can be washed thoroughly without any fear of removing desirable tanning salts or of interfering with the character of the leather.

The operation of dyeing and fat-liquoring can be immediately proceeded with, and because of the even absorption of moisture by the leather these processes proceed very uniformly and are consequently facilitated.

After the goods are "set out" from the fat-liquor they can be tacked out at once, a process which yields a considerable gain in the measurement, and is accomplished without affecting the character of the leather.

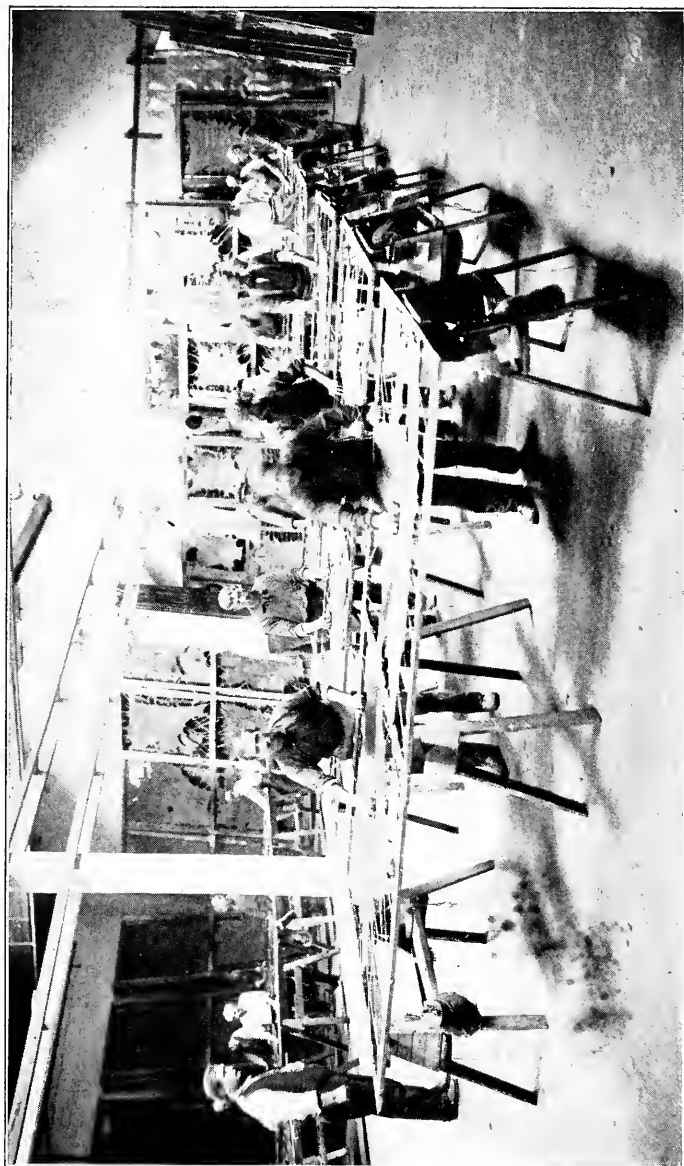
Where it is desired to experiment with this process on a small scale, it is recommended that the bath in which the goods are treated be made up by volume rather than by the weight of the wet leather.

A suitable strength is one-third of standard lactic acid and two-thirds water.

In combination tannages of chrome and a vegetable tannin, the fixation of the latter is brought about more intimately by treating the stock after the chrome bath with a bath of lactic acid.

The development of the chromium tannage for the heavier leathers, such as sole, harness and belting leathers, will in all probability proceed along the lines of a compromise, and result in the production of a combination tannage of chromium and a vegetable tannin.

In order that the fixation of the combined tannages on the fiber shall be so intimate as to permit of the vegetable tannin acting jointly as a tanning agent and a "filler," and that the result will produce a leather superior to either of the tannages employed independently, a bath of lactic acid after the chrome bath, and before treatment with the tannin liquor, ensures the fixation of an organic acid on the fiber which is in sympathy, as it were, with the organic tannins and brings about a more complete assimilation of them.—*Robert W. Griffith, in Shoe and Leather Reporter.*



FINISHING PATENT LEATHER.

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SECTION ELEVEN.

RECEIPTS, FORMULAS AND MISCELLANEOUS INFORMATION.

HOW TO NEUTRALIZE CHROME LEATHER.

WHEN borax, which is a good neutralizer and cleanser, is used the boric acid which is liberated must be washed entirely from the skins or else trouble will ensue in the coloring of the leather. If sodium phosphate is used the phosphoric acid unites with the chromium, forming chromium phosphate, which is insoluble in water and also in very weak acids that might be employed in dyeing. In order that the free phosphoric acid may be removed something must be used that will produce the result and not effect a detriment to the skins.

This is best accomplished by the use of bicarbonate of soda. The process is most suitably carried out in water at 90 to 100 degrees Fahr. Very good results have been obtained by using from two to three per cent. of sodium phosphate of the weight of the skins for the first bath. Then allow this liquor to run off, after which put in about .05 per cent. of the sodium bicarbonate and run the drum fifteen minutes, the temperature of the water being about 80 degrees Fahr. The first bath in which the sodium phosphate is used should be of the same temperature, and the drum be run from twenty to forty minutes. The tanner using this process must remember that these figures do not apply to all classes of skins, and he must vary the quantities with their quality and condition. Borax, if used, should be well washed away. The two chemicals mentioned above are cheaper than borax.

DRESSING FOR LEATHER FURNITURE.

A dressing for leather furniture is made as follows: Put into a bowl one gill of hot water, half an ounce of annotto and half

an ounce of white soap, shaved fine. Place the bowl in a pan of boiling water. Into another bowl put half an ounce of beeswax, shaved fine, and place it in the pan of boiling water. Stir the contents of both bowls until they are melted, then take them from the fire. Into the melted wax stir one gill of turpentine, one gill of paraffine oil, and then the mixture of annatto, soap and water. Beat the mixture until it is cold, then put it in a wide-mouthed bottle or fruit jar for future use. This preparation may be used on brown or red leather. First wash the leather with a soft cloth or sponge and hot milk, then rub on the dressing with a soft cloth. If the leather be faded the dressing may be made darker by using two or three times the quantity of annatto. For dark green or black leather add a little logwood to the mixture.

WATERPROOF LEATHER DRESSING IN PASTE FORM.

Petrolatum.	4 pounds.
Burgundy pitch.	4 ounces.
Rosin	2 ounces.
Ivory black (dry).....	6 ounces.
Beeswax.....	4 ounces.

Melt the rosin, pitch and beeswax together, then add the petrolatum, and when melted stir in the ivory black and continue stirring until cold.

Apply the dressing to the leather with the fingers or a soft cloth, rubbing it well in. If the leather is dirty, wash it with a sponge and a little soap and warm water before applying the dressing. It gives a nice black, but not a high polish. It will make any piece of leather soft and pliable as when new if used according to directions, no matter how hard or watersoaked the leather has become. A strap treated in this way may be immersed in water for a week without absorbing any. Used as a shoe dressing it renders the use of rubbers unnecessary.

HARNESS BLACKING.

Mutton suet.....	2 ounces.
Yellow wax.....	6 ounces.
Powdered sugar.....	4 ounces.
Yellow soap	2 ounces.
Lampblack.....	1 ounce.
Indigo (powdered bluing).....	4 ounces.
Water	4 ounces.
Oil of turpentine	4 ounces.

Dissolve the soap in the water, add the other ingredients except the turpentine, melt and mix thoroughly together, then add the turpentine.

This mixture is applied to the harness with a sponge and polished with a brush.

OAK STAIN FOR HEMLOCK LEATHER.

Extract of quercitron bark.....	13 pounds.
Alum.....	10 pounds.
Sumac.....	12 pounds.

Boil in one-half barreelful of water until all is dissolved, then fill the barrel up with water and stir the liquor well before using it. Use at a temperature of 105 degrees Fahr. with a brush after scouring, and apply very liberally.

It is best to put the sumac in a bag. It will take a little longer to get the strength out, but it will not cause so much trouble in straining afterwards.

OIL BLACK.

Lampblack	20 pounds.
Logwood extract.....	2½ pounds.
Tallow	70 pounds.
Good bark liquor	12 gallons.

After mixing, boil for twelve hours, and when cool stir well to keep from separating. This black is varied more or less to suit different leather, the same as finishes, as no one finish will work the same on all kinds of stock, and should be manipulated to get the best results.

HOW TO MAKE CASTOR OIL SOAP.

Castor oil soap is an excellent material for fat-liquor. It can be made in the tannery in the following manner: Dissolve two pounds of caustic soda in a gallon of water. Heat two and a half gallons of castor oil to 90 degrees Fahr., then pour the soda solution into the warm oil, continually stirring the mixture until it becomes thick. Cover up the tub containing the soap and let it stand over night in a warm place. The next day the soap is ready for use. It is advisable, but not absolutely necessary, to melt the soap again in a jacketed pan fitted with a stirring apparatus. By means of this apparatus a better and more even mixing of the soap is obtained.

HOW TO SOFTEN HARD WATER.

Water that is made hard by carbonate of lime may be softened by the use of quicklime, sal soda or ammonia. When there is time to allow the water to settle, lime is the best material to use. To soften with lime have the water in a large tank or hogshead. Pour enough water on the quicklime to slake it. When it falls to powder add enough water to make a thin cream and then stir this into the water to be softened. Use one ounce of lime for every forty gallons of water. Do not let any undissolved lime go into the water. Allow it to stand for twelve hours. The carbon dioxide, which held the carbonate of lime in solution, will be absorbed by the lime and the liberated carbonate of lime will fall to the bottom, leaving the water soft.

HOW TO CLEAN VATS AND DRUMS.

The best way to clean a vat that has held bark or extract tan liquors is by the use of sal soda and sulphuric acid. Fill the vat with hot water and dissolve in it fifty pounds of sal soda. Let the water remain in the vat twenty-four hours, then run it off and fill the vat with clean, cold water; then put seventy pounds of sulphuric acid into the water, plunge thoroughly and allow to stand twenty-four hours; then run the acid water

off and the vat will be found to be free from all traces of vegetable tannic acid.

Drums that have been used to dye leather black in cannot be very well cleaned so as to be employed for coloring lighter shades, but if used simply for dark shades of tan they may be cleaned with permanganate of potash and bisulphite bleach. Run a hot five per cent. solution of permanganate of potash in the drum for half an hour or so. Then draw it off, and a thick, brown deposit of oxide of manganese will be found on the surface of the wood. This is then dissolved by a ten per cent. solution of bisulphite of soda, and a great deal of the color will also be taken off. If there is much color in the wood the treatment can be repeated. Finally the drum should be washed very thoroughly with several changes of hot water.

HOW TO REMOVE STAINS FROM THE HANDS.

Moisten slightly in the palm of the hand a teaspoonful of permanganate of potash, rub it thoroughly into the skin and wash. By the subsequent use of bisulphite of soda the permanganate is completely removed, together with all aniline stains, etc. This treatment makes the hands soft and white and does not injure the skin.

A GOOD CHROME LIQUOR.

A satisfactory one-bath chrome liquor is made of five parts by weight of bichromate of potash to two parts by weight of glucose, each dissolved separately in water and the solutions then united. A quantity of sulphuric acid is next diluted with three or four times its weight of water, the acid being added to the water and not the water to the acid. The acid solution is then poured very slowly into the bichromate of potash and glucose liquor until the latter assumes a deep green color. Great heat is produced and the acid must be added very slowly. In using this liquor the skins are drummed in a solution of salt for ten minutes; then the chrome liquor is added, a small quantity at a time, and the goods are run in the liquor until

they are tanned through. Heavy skins should be retanned after they have been shaved.

The tanned skins are washed and shaved, next mordanted with sumac, palmetto or gambier and then fat-liquored. After they are fat-liquored, they are colored with acid dyes as they need not be set and are not easily removed.

POTASH SOAP.

For any purpose for which a potash soap is required it is essential to use a pure article; but unfortunately this is not always readily obtainable. To be sure of having a pure product, the safest course is to make it. This is easily done as pure caustic potash is readily obtained. A good soap can be made, even with crude appliances, according to the following formula: Put 224 pounds of red oil in a kettle and heat it to 100 degrees Fahr.; then run in slowly with constant stirring 10½ gallons of solution of caustic potash 60 degrees Twad. Allow to stand 24 hours, and the soap is made.

PREPARING DEFIBRINED BLOOD.

Thoroughly clean a barrel with hot water containing borax and fill it half full of fresh beef blood. Then take a stick or a broom handle and beat the blood well up for about twenty minutes. By this heavy beating the fibrin begins to thicken very soon, and it can then be removed with a shovel.

The remaining fluid blood is purified and is called defibrined blood because the fibrin, the portion that wastes away, has been removed. To preserve the blood, one pint of pyrogallic acid is added to a barrel of it and mixed by stirring for several minutes. The blood must be kept in a cool place, and the barrel should always be closed after a supply has been taken out. The defibrined blood will keep for almost one year, and will furnish bright and good finishes.

TO MAKE LEATHER WATERPROOF.

Viscol applied to leather makes it waterproof. The best results are obtained when the leather contains no oil or grease.



Glazed and patent leather, as well as dull and box finishes, can be easily viscolized. This treatment plumps the leather, gives it a better feel and preserves it by protecting it from water.

The viscol is applied as follows: Pour it onto the flesh side of the leather by means of a dipper, and distribute it evenly over the surface with the hand until it has struck through to the grain and the leather absorbs no more of the liquid. When this is the case, quickly and thoroughly wipe off the excess of the dressing on the surface with a soft brush, returning the liquid to the dipper by drawing the brush firmly over the edge of the dipper. When the surface has been thoroughly wiped in this way the leather should be hung up to dry for about twenty-four hours. Care should be taken to avoid getting any of the dressing on the glazed surface of the leather. While it does not harm it in any way, there is the extra labor of removing it, which, however, can be easily done by rubbing it with a cloth wet with naphtha before the leather is hung up to dry.

Leather improves if it is kept several weeks after treatment with viscol. If there is any oil or grease in it, viscol drives it to the glazed surface, and thus the bright finish becomes dull. The leather cannot be glazed after it has been treated with viscol; for winter shoes it can be made absolutely impervious to water by the treatment described. Sole leather also can be viscolized.

TO PREPARE STRIKER FOR TABLE COLORING.

Dissolve four and one-half pounds of copperas and one and one-half pounds of blue vitriol in half a barrellful of water; fill the barrel up to a total of fifty gallons. For use on a machine, dissolve twelve pounds of copperas and four pounds of blue vitriol for each barrel. To the above add one and one-half pounds of nutgalls and one pound of Epsom salts to each six pounds of copperas and blue vitriol combined. Use this liquor after logwood to develop the black.

TO CLEAN WHITE FUR RUGS.

The best way to clean white fur and wool rugs is by the use

of powdered chalk and water. A thin paste is prepared by mixing chalk and water, which is thoroughly rubbed into the wool or hair side of the skin and then allowed to dry. After the paste is dry it is thoroughly brushed out with a stiff brush, and to finish a finer brush is used to remove every particle of chalk. This treatment takes away all dirt and grease and causes the skin to be not only clean but also soft and fluffy.

BLACKING FOR THE EDGES OF CHROME LEATHER.

The edges of chrome harness and other leathers can be blacked with the following blacking: Two pounds of logwood crystals, one and one-fourth pounds of black nigrosine and one and one-half pounds of sal soda are boiled in nine gallons of water and allowed to cool. One and one-half ounces of blue vitriol and one ounce of bichromate of potash are boiled in three quarts of water and allowed to cool; the solution is then slowly stirred into the logwood liquor. The blacking is thoroughly stirred, one pint of ammonia added, and then enough water poured into the vessel to make twelve gallons of blacking.

TO PRESERVE BLOOD.

Blood is much used as an ingredient of leather finishes and seasonings, and if not treated with some preservative, is apt to spoil quite rapidly. In order to keep it for some time, either carbolic acid or formaldehyde is added to it. One pound of carbolic acid crystals is dissolved and the solution stirred into the blood, this quantity being sufficient for a barrel of it. Five drops of formaldehyde mixed into a quart of blood also hinders the deterioration of the latter.

TO HARDEN LEATHER.

To harden welt leather, melt two hundred pounds of grape sugar in a kettle with seven gallons of fish oil. Heat the mixture to 135 degrees Fahr., and the mill to 150 degrees Fahr. Use eighteen per cent. of this mixture for one hundred pounds of welt leather. If properly applied, this will produce nice, firm welting.

To harden harness leather in hot weather, the following receipt will produce good results. Melt two hundred pounds of stearine and fifty pounds of paraffin wax in a kettle at about 135 degrees Fahr. Then heat the mill to 150 or 160 degrees Fahr. Add twenty pounds of this mixture to every one hundred pounds of wet harness leather ready to be stuffed. If this proportion is not enough make it twenty-five per cent. Mill the leather for thirty minutes and then remove it, hang it up to cool, and in due time it will be ready to set.

IVORY OR CASTILE SOAP FAT-LIQUOR.

A good fat-liquor for light upper and glove leathers is made of:

Ivory or Castile Soap.....	10 pounds.
Cod or Neatsfoot Oil	2 gallons.
Egg Yolk.....	10 pounds.

Shave or cut the soap and let it soak some hours. Then boil it in a clean barrel with a few gallons of water until dissolved. Next cut the oil by stirring into it two ounces of dissolved borax. Then add the oil to the soap solution, stirring thoroughly for several minutes. Next add enough cold water to make forty-five gallons of liquor and then stir in the egg yolk. Apply this fat-liquor at 95 degrees Fahr., using two gallons or more for each dozen skins. The liquor should always be cooled by adding cold water before the egg yolk is stirred in.

CASTOR OIL FAT-LIQUOR.

For Chrome-tanned Skins.—For chrome-tanned skins, especially colored ones, castor oil soap and castor oil make an excellent fat-liquor. One-half pound of the soap and three-fourths pound of the oil may be used in ten or twelve gallons of water for one hundred pounds of skins. The fat-liquor is prepared in the usual manner and applied at the usual temperature.

For Vegetable-tanned Skins.—Ten per cent. of castor oil soap and five per cent. of castor oil calculated on the weight

of the dry leather make a good fat-liquor for vegetable, combination and bark tanned skins, making them well-filled and soft. They should be uniformly damp and drummed in the liquor until the oil and soap are entirely absorbed, then hung up and dried. Fat-liquoring can also be done immediately after the skins are tanned, washed and pressed; they are then dried and colored later. Or they can be dried from the tan, then fat-liquored, and finished.

COLORING PROCESS FOR VEGETABLE-TANNED SKINS.

Any kind of vegetable-tanned skins can be colored in the following manner: Sort the dry skins, dip them into warm water in a tub and place them in a pile, covered up, for twenty-four hours to become soft and dampened through. Take one-half pailful of sumac and scald it with boiling water for two hours in a closed vessel. When it is ready to use, add ten gallons of water and one gallon of lactracine. This is sufficient liquor for ninety to one hundred skins. It should be used at 100 degrees Fahr., and the skins be drummed in it for twenty-five minutes. They should be put into the drum, the latter started and the liquor then poured in through the hollow axle. At the end of the twenty-five minutes, the liquor should be drained off, the solution of dye put into the drum and the skins run in it until colored.

Very dark and India-tanned skins should be first washed in warm borax water, then cleared with sulphuric acid, washed, and then treated with sumac as described.

BLACKING FOR VEGETABLE-TANNED LEATHER.

The following is a good blacking for heavy vegetable-tanned shoe and harness leathers. Copperas, nine pounds; Epsom salts, one-fourth pound; acetic acid, six ounces; nutgalls, one ounce. Put these ingredients into two gallons of soft water and boil until dissolved. Then put the solution into a barrel and add forty gallons of water; stir thoroughly and the blacking is ready for use.

If the leather has a loose, open grain it is advisable to put into the barrel four or five gallons of strong gambier liquor in place of the same amount of water. This will tighten up the grain and prevent it from piping when finished. Another good receipt is: One barrel of gambier liquor showing 10 degrees test by the barkometer. To this add fifteen pounds of copperas, two pounds of Epsom salts, and four ounces of powdered nutgalls. Dissolve first the copperas and nutgalls in a pailful of hot water, then add the solution to the gambier liquor. This is especially suitable for quebracho-tanned harness leather.

BLEACHING THE FLESH OF HEMLOCK-TANNED HARNESS LEATHER.

A light oak appearance on hemlock harness leather may be secured by the use of brown sugar of lead and sulphuric acid. In a gallon of water is dissolved one pound of the sugar of lead and the solution is added to ten gallons of warm water. Twenty-five sides of leather are drummed in this solution twenty minutes. The waste liquor is then drawn off and a dilute solution of sulphuric acid put into the drum. To twelve gallons of water enough acid is added to make the water as sour as lemon juice; the leather is drummed in this solution fifteen minutes and then washed in clear water.

The two solutions can also with good results be applied to the flesh. The sugar of lead solution is brushed evenly over the flesh, next the acid solution is applied and the leather then rinsed off. The hemlock color will be turned to a light oak color by either of these treatments.

RECEIPTS FOR MAKING SIG.

1. To make one barrel of sig use either of the following formulas:

Salts of tartar	12 pounds.
Bichromate of potash.....	5 pounds.
Ammonia 26°.....	1 quart.
Water.....	40 gallons.

Boil the salts of tartar and bichromate of potash in twelve gallons of water; when dissolved, add water to make forty gallons, and then the ammonia, stirring thoroughly. If kept for any length of time it may be necessary to add more ammonia.

2. Use a fifty-gallon barrel and boil in twelve gallons of water

Caustic soda	12 ounces.
Salts of tartar	12 ounces.

When dissolved, fill barrel with cold water.

TO REMOVE GREASE SPOTS FROM LEATHER.

If the spots are not very large they may be removed by laying blotting paper on them and then ironing out with a hot steel. The heat dissolves the grease and causes it to pass from the leather into the paper. By several times repeating this process, the grease spots may be removed without injuring the leather.

Another process consists in preparing a dough composed of one part cooked mashed potatoes and one part mustard flour prepared with turpentine. This preparation is put onto the grease spot and allowed to dry. When dry it is rubbed off and the spot is cleaned with a rag which has been dipped into wine vinegar; lukewarm water is finally used to wash out.

TO REMOVE TANNIN FROM LEATHER.

Prepare a two or three per cent. solution of sal soda; use it at 115 degrees Fahr., and drum the leather in it for fifteen minutes. If this does not remove enough of the tannin, drain the solution off and drum the leather in a fresh solution fifteen minutes longer. Tannin can be safely extracted from leather in this way.

GOOD FAT-LIQUOR FOR LIGHT CHROME LEATHER.

The formula here given makes an excellent fat-liquor for light shoe or glove leather:

Fig. soap	1½ pounds.
Neatsfoot oil	½ pound.
Olive oil.....	¾ pound.
Glycerine.	1½ pounds.
Yolks of eggs	Twenty-five.

Boil the soap in six gallons of water until it is dissolved, then add the oils and glycerine and stir thoroughly. When the mixture has cooled down to 85 degrees Fahr. add the yolks of eggs and a little salt. Enough water is then added to make a barrelful of fat-liquor.

WHITEWASH FOR HIDE CELLARS AND BEAMHOUSES.

A good whitewash is made in the following manner: Put a piece of lime weighing five pounds in a pan or pail, pour on it a gallon of water, allow it to boil, and slake until the steaming is over. Then put two quarts of the liquid lime into a pail and add sufficient water to make it rather thin. Add a small amount of blue indigo or bluing, sufficient to give the proper color; add a teaspoonful of salt and half a teaspoonful of lampblack, and stir well. A large quantity of whitewash can be made by using the proper proportions of material in larger quantities.

An excellent whitewash is also made by adding a pound and a half of white vitriol, a pound of salt and half a pound of dissolved glue to a peck of slaked lime. The salt and glue in the whitewash prevents it from rubbing off.

Another good receipt is as follows: Slake twelve quarts of stone lime with boiling water, keep it covered till it cools a little and strain it; add eight ounces of alum, two pounds of sugar, six pints of rice flour boiled to a thin paste with water, and two pounds of glue previously dissolved. Stir these ingredients well and add ten gallons of hot water. A small piece of copperas as large as a walnut will impart to it a buff shade.

TO BLEACH SKINS WITH THE HAIR ON.

Goat, sheep and lamb skins intended for rugs, robes, etc., can be bleached by using a solution prepared in the following manner: Four and one-half pounds of chloride of lime are mixed

into twenty-one quarts of water, the solution being frequently stirred for some time. It is then allowed to stand until it has settled, when the clear liquor is drawn off into a solution of ten and one-half quarts of water, in which five and one-half pounds of Glauber's salt have been dissolved. A precipitation results which leaves hypochlorite of soda in solution. The clear liquor, which should be quite free from lime, is next drawn off and the skins are immersed therein until thoroughly bleached, which takes about two days. When bleached they should be rinsed off and then washed in weak suds of white soap in order to give them the necessary soft feel. Previous to bleaching they should be washed with warm suds and rinsed. Alum-tanned skins may require a retannage after bleaching. This is done by rubbing alum and salt into the flesh side before hanging them up to dry.

DYEING CHROME AND OOZE LEATHERS BLACK WITHOUT LOGWOOD.

Leather Black 4 B X is a dye that will produce, without the use of logwood, a deep black on chrome-tanned leather. The leather is first completely neutralized, washed and shaved, and then colored in a drum, with a solution of this dye, at from 120 to 160 degrees Fahr., the hotter the better; the solution of dye should contain one-half per cent. of borax. The leather is then rinsed and finished.

Leather Black J O in conjunction with Leather Black 4 B X produces a deep black color on ooze leather. The leather is first dyed with Leather Black 4 B X, then rinsed and dyed with Leather Black J O. These dyes can be obtained from I. Levenstein & Co., Boston, Mass.

LOGWOOD LIQUOR.

To make a logwood liquor of logwood crystals, hemolin or other logwood-product dye, use five pounds of the crystals and boil them in twenty gallons of water until dissolved; then fill the barrel up with water, adding sal soda, borax or other alkali

to effect easy penetration, say from eight ounces to a pound to the barrellful of dye. The dye is now ready for use. Greasy leather requires more sal soda in the dye than stock that is not greasy; a sig is also necessary.

One and one-half pounds of logwood crystals and three or four ounces of alkali will color one hundred pounds of chrome leather. A deeper black than with logwood alone is produced by the addition of a few ounces of fustic paste to the logwood liquor.

DYEING CHROME LEATHER WITH LOGWOOD AND NITRATE OF IRON.

This process of dyeing leather black can be used on any class of chrome leather. The quantities of dyeing material required for one hundred pounds of leather are :

Logwood crystals	1½ pounds.
Black nigrosine.....	1 ounce.
Acetic acid.....	1½ ounces.
Nitrate of iron.....	3 ounces.

Boil the logwood in three gallons of water, then add four gallons of water and drum the leather in the solution ten minutes; next dissolve the nigrosine in hot water and add it to the contents of the drum and drum ten minutes. In the meantime dissolve the acetic acid and nitrate of iron in two gallons of water, pour the solution into the drum at the end of the second ten minutes and allow the drum to rotate twenty minutes longer. The liquor should then be run off, the leather washed and fat-liquored.

FINAL DRESSING FOR BOX CALF.

Dissolve five ounces of extract of archil in one pint of warm wood alcohol; also dissolve four ounces of blood albumen in six quarts of warm water. When thoroughly dissolved mix both solutions together by shaking vigorously in a tightly-corked jar.

HIGH-GRADE SHOE POLISH.

The formula given below produces a shoe polish in paste form that compares favorably with any on the market:

Beeswax	1 pound.
Ceresin	1 pound.
Carnauba wax	6 ounces.
Turpentine.	3 pints.
Yellow soap.	6 ounces.
Oil-soluble black aniline	Enough to color.
Water	Sufficient.

Shave the soap and dissolve it in the smallest possible quantity of water by means of heat; melt the waxes together; add the turpentine and stir well; then add the aniline dye and stir in the soap solution, continuing to stir until cold. The consistence of the paste may be varied by using more or less turpentine and water.

FINISH FOR COMBINATION BOX CALF LEATHER.

Dissolve four ounces of methyl violet aniline 6 B in ten quarts of water and boil until dissolved. After cooling, add six quarts of ammonia and twelve gallons of beef blood, and then carefully a cold solution of eight ounces of bichromate of potash dissolved in ten quarts of water. Also add two and one-half pounds of logwood extract boiled in six gallons of water, but do not mix in until this solution is cold. Add a little carbolic acid, strain the mixture, and it is ready for use. Glaze and grain the leather.

TO PREVENT THE PLEATING OF LIGHT SKINS DURING GLAZING.

One of the greatest difficulties encountered in the finishing of light skins, especially chrome-tanned stock, is the ease with which they pleat while being glazed. On account of the soft and thin condition of the leather the glass is apt to form deep and sharp folds by laying over the grain, all efforts to remove them leaving the leather in a half-damaged condition. If the leather is very soft and thin the most skilful finisher cannot

prevent these folds, and during the glazing operation there is constant danger of damaging the skins. Sometimes the glass cannot pass over the fold, and the skin is either torn or is dragged along and becomes badly crumpled and soiled. Injury to the workman has often occurred in his efforts to save the skin. These difficulties can be avoided, at least to some degree, by tacking the skins while wet on frames or boards after they have been staked, and glazing for the first time directly off the frames or boards while they are flat and stiff. They will be flat and sufficiently stiff to prevent the grain from pleating. If glazed once they will glaze easily a second time, even if they are staked after the first glazing. Another remedy consists in applying a weak tannin solution to the grain. The effect of this is to cause the glass to slip with greater ease than when the skins are dry, and the danger of pleating the grain is thereby somewhat prevented. Moistening and tacking the skins is, in the writer's judgment, the best way to stiffen them so that they can be glazed the more readily the first time.

TO BOIL LOGWOOD CHIPS.

Put the chips into a coarse bag, tie it and put it into the water. Turn on steam and boil thoroughly. The chips should be put loosely into the bag. As soon as they are sufficiently boiled they should be taken out of the liquor, as the strength will go back into them when the liquor cools if they are left in. Some of the sal soda or borax used to cut the grease should be dissolved in the liquor before the chips are taken out. When they are boiled loosely in the liquor the latter should be strained immediately after boiling to remove them. Copper pipe or coil should always be used, since iron pipes, especially rusty ones, cause the leather to have a defective color.

THE PREVENTION AND TREATMENT OF CHROME SORES.

Workmen employed in chrome leather tanneries where the two-bath process is used are often afflicted with what are commonly called *chrome sores*. These sores are caused by the

poisonous bichromate of potash and acid liquor that constitute the first bath. Unless properly attended to, they are apt to eat very deep into the flesh and to become very painful. Ordinary ointments and salves do not seem to have any effect although they help some, if the workman will take up some other line of work. An ointment which is said to be a very efficacious preventive of the sores was originated by Dr. Lewis Levi, chemist of the Pfister and Vogel Leather Co., of Milwaukee, Wis., and has been used by him in the treatment of them. The formula is as follows:

Petrolatum.....	3 parts.
Lanolin	1 part.

Melt on a water-bath or stove; when melted and thoroughly mixed add five drops of 90 per cent. pure carbolic acid to every four ounces of the mixture. Pour the mixture into a glass or earthenware jar and allow it to solidify, when it is ready for use.

The ointment should be applied as follows: Let the workman clean his hands and arms thoroughly with soap and water. Rinse with warm water and while the skin is moist apply the ointment. Rub in well so as to cover all exposed skin, for about two or three minutes. Then wipe dry with a clean cloth. The skin will be left entirely dry and with no greasy feeling. This ointment can also be used for chapped hands. For those who work in water, it has shown itself to be an excellent preventive against the effects of the rapid change of temperature from warm to freezing. To prevent chrome sores apply the ointment once or twice daily. To prevent and cure chapped hands apply it as for chrome sores. This ointment can also be used with excellent results for burns, scalds, etc. The theory for the use of the ointment is as follows: Lanoline is absorbed by the skin and petrolatum forms a light coating on the surface. The application of the two inert substances prevents the action of the chrome upon the surface, and should the outer coating of petrolatum wear off, its action is at the same time prevented by the absorbed grease. Tests and trials have proved that this ointment will do all that is claimed for it.

A five per cent. solution of sodium bisulphite is recommended by Herman S. Riederer, Ph. D., as a wash for chrome sores. Practical demonstration has proved the efficacy of this treatment. A workman had a sore for eight or nine months, as it could not be bandaged to keep it clear of continuous infection by chrome compounds. Sodium bisulphite solution was applied twice each day. About the second or third day the pains disappeared, and whereas before treatment the whole region of the sore was very sensitive, it could now be manipulated so as to work the solution into all parts of the sore, which had spread about three-quarters of an inch from the original point of infection and extended a considerable distance under the skin beyond the opening of the wound. The sore was completely healed in about three weeks. Incipient sores put under the treatment healed naturally without any unusual scar. Workmen in a chrome plant were given this solution to use as a supplementary wash after work and a decided improvement in their condition was immediately apparent. Few sores appeared, and those were easily checked and cured, giving the men a possibility of attending to their work regularly and efficiently.

Chrome sores are caused by a small amount of chromate or bichromate getting into a scratch or other wound and then eating along under the skin, often for some distance from the place of initial infection. A watery excretion, generally more or less green, is usually present. A scab which forms at times is no indication of healing. The pains are very severe, occasionally interrupting, and even preventing, sleep. Rubber gloves should be worn by the workmen who handle the bichromate of potash and the skins from the first bath, and the ointment should also be applied to the hands and arms. And as soon as a sore appears, if one does appear in spite of the precautions, the sodium bisulphite solution should be used.

ACID BURNS.

Strong acids, such as sulphuric and muriatic, coming in con-

tact with the skin cause great pain and destroy the tissues. Dilute ammonia, chalk, carbonate of magnesia, or some other alkali should at once be applied to neutralize the acid. After an hour or so the following mixture should be applied: Olive oil, two ounces; lime water, two ounces; carbolic acid, fifteen drops. Wet a soft cloth with this mixture and apply, changing two or three times a day, if necessary. Linseed oil may be used in place of olive oil. This preparation should be kept on hand in tanneries, as acid burns occur quite frequently.

BRIGHT BLACKING VARNISH FOR SHOE LEATHER.

This varnish comes very handy to parties running a small shop who want to produce bright black polish on grain shoe leather of any tannage and yet have not the necessary machinery for doing such work as it is done in large factories.

Dissolve in a bottle, tightly corked, one ounce of caoutchouc in one ounce carbon bisulphide and let the solution stand a few days. Next dissolve three ounces of orange shellac, half an ounce of gum sandarac, one and a half ounces of gum mastic and five ounces of pure Venetian turpentine in two quarts of alcohol. Add the turpentine after the other gums are dissolved. When all three materials are well mixed add the caoutchouc solution. Put the vessel containing the complete mixture in another vessel of hot water and heat to about 120 degrees Fahr. Then add one ounce of black aniline. Keep the whole for about one hour in water at 120 degrees Fahr. Then put in a jar, cork tightly, and let it stand for at least two weeks before using. It improves with age.

For use, dissolve two ounces of gelatine (isinglass) in a quart of water and boil until dissolved. To this add one ounce of indigo blue and then two quarts of cold water. Let the solution cool and place it so as to see that the mixture is not too thick, as the heat of the shop or summer weather has much to do with the amount of water that gelatine will absorb. The mixture should be like thin jelly.

The mixture is prepared by heating the gelatine a little and

straining through cheese-cloth; then mix equal parts alcohol, gum and gelatine, and stir until it sets or gets thick. While stirring add to each gallon of the mixture one and one-half ounces of glycerine. When it is well set it is ready to be applied to the leather.

Two thin coats should be evenly spread on the grain with a sponge and well rubbed in with a fine sponge or with a soft hairbrush in a warm room. Let the first coat get dried in before applying the second. After the last coat is absorbed, glaze the leather slightly by hand so as to produce the soft feeling the stock had before the varnish was applied. If these instructions are carefully carried out the result will surprise and please whoever tries the experiment.

LACTIC ACID IN COLORING LEATHER.

When leather has a greasy grain it should be opened and cleared before any dye is applied. Dissolve one gallon of lactic acid in a barrel of fifty gallons of warm water and drum the skins in this solution thirty minutes. When the basic aniline colors are to be used it is necessary to wash the skins in warm water after this treatment, but if acid anilines are to be employed, washing is not necessary. Sheep leather dyers have found that by giving their skins this treatment they are enabled to get clearer and more even colors, as this operation not only clears the grain of greasy matter, but at the same time opens up the grain a little and allows the dyestuff to go on evenly.

Lactic acid and bichromate of potash in solution are useful as a mordant and striker. To fifty gallons of warm water add two pounds of the potash and one gallon of the acid. On light colors this solution may be used at the end of the dyeing operation as a striker and evener. In the case of making dark colors, such as browns, chocolates, dark tans, etc., it should be employed as a mordant. For some dark colors it is desirable to use a solution of the mordant, then apply the dye, and strike with copperas.

HOW TO GET A BLUE BACK WITH NIGROSINE.

For each dozen chrome-tanned sides or an equivalent number of skins, dissolve eight ounces Nigrosine P. in water at 120 degrees Fahr.; put the solution into the drum, together with the leather, and run the drum twenty minutes, or until the color is well taken up. Now drain off the water, press or strike out the leather and fat-liquor it; then black the grain with logwood and striker, oil the grain with sperm, neatsfoot or paraffine oil, dry the leather, and proceed to finish it in the usual way. The back of the leather will be dark blue and the grain jet black as a result of this treatment.

HOW TO CLEAN BARRELS.

It is sometimes necessary to cleanse barrels or other wooden vessels. A solution of sal soda should be used. The barrel should be filled half full of boiling water, and a solution of two pounds of soda in a gallon of hot water poured in and the water thoroughly stirred. The barrel should then be filled to the bung with water and allowed to stand twelve hours or longer, when it should be emptied, filled with pure water, left a few hours and then thoroughly rinsed, when it will be ready for use. Another way to cleanse a barrel is to put a few pounds of unslaked lime into it, add water and cover. After a few hours add more water and roll the barrel. Rinse thoroughly with clean water.

TO KEEP PATENT LEATHER SOFT AND TO RESTORE THE GLOSS.

Add to some pure wax, melted in a dish set in a pan of boiling water, some olive oil and then some lard. Mix thoroughly by stirring over a fire. Add some oil of turpentine and a little oil of lavender. This will form a paste, which should be put in boxes. Apply with a soft rag; rub with flannel.

FORMULA FOR PRODUCING PLUMP LEATHER.

Soaking.—Dissolve five pounds of borax in hot water and add the solution to 1000 gallons of water; soak the hides from

twenty-four to forty-eight hours, changing the water if necessary when they are very dirty. They should be as clean as possible before they are put into the lime.

Liming.—The best process depends somewhat on the kind of stock being made. Starting the hides in new and strong limes and finishing up in weak ones makes the leather very plump as well as soft, but as extreme plumping at the start tends to weaken the fibers, it is better to start liming in weak limes and finishing up in strong ones.

Bating.—Place the sides in a vat provided with a wheel, into which a solution of three pounds each of sulphuric acid, borax and Glauber salts, thoroughly dissolved, has been brought, together with about six barrels of water, or enough to cover the hides. Five hours will be long enough to keep them in, provided they are quite often stirred with the wheel. The same process in a vat without a wheel will take thirty-six hours.

Tanning.—Suspend the hides in a liquor made up by putting six pounds of borax (dissolved) into a vat containing about twelve hundred gallons of weak hemlock liquor. Keep them in until the color is struck, then pump the liquor into a leach of bark, and steel it for a second run; add no more borax until after the third run, then add two and a half pounds of it (dissolved) to the liquor that is to be pumped into the leach for the fourth run. Then finish up the tanning with quermos or quebracho extract liquors. In depending too much upon quebracho as a tanning agent without anything else, plumping and filling qualities are lost, which are gained by using hemlock bark or extract liquor as a striker. Be sure and use the borax as directed.

FAT-LIQUOR FOR COMBINATION-TANNED LEATHER.

Boil twenty-five pounds of Palermo fig soap in a half-barrelful of water, then stir in fifty pounds of English sod oil and one and a half gallons of any other good leather oil, saponify thoroughly and add water to make fifty gallons of fat-liquor.

When the leather is taken from the tan, press out the surplus

liquor and let it lay in a pile for forty-eight hours. Heat the drum with hot air or steam and add one gallon of No. 1 Clarified Leather Oil to each one hundred and fifty pounds of leather and drum the latter forty minutes, or until the oil is taken up. Now take the leather from the drum and hang it up to dry; when dry, wet it in a tub of warm water and leave it a few hours in piles to soften.

Shave the leather if necessary to make it of uniform thickness, then put it into the drum and run it with just enough water to wet all parts alike; drain off any water in the drum and add twenty gallons of fat-liquor, at 110 degrees Fahr., to each one hundred pounds dry-weight stock. More or less fat-liquor may be used as required by the particular tannage, this being the maximum quantity.

Drum the fat-liquor well into the leather, then hang the stock up and dry it again.

EUROPEAN FAT-LIQUORS.

The following formulas for fat-liquors are frequently used by European tanners of chrome leather:

1. One pint neatsfoot oil and one pint-cod oil are stirred together with one pint of a ten per cent. solution of soda, and this mixture is poured, stirring continually, into a hot solution of three pounds soap chips in six pints of boiling water.

Five to ten per cent, of the shaver's weight is then added to the necessary amount of water, *i. e.*, for one hundred pounds of leather (shaver's weight) about ten gallons of hot water are taken.

2. Four pounds of soft soap are dissolved in one gallon of boiling water; then add one and one-half pounds of degreas and twelve ounces of soda previously dissolved in water. Five to ten per cent. of this mixture is thinned with the necessary amount of water as above.

3. Five pounds of soap chips are dissolved in sufficient boiling water; then warm four pints of neatsfoot oil and stir it into the soap solution. Dilute the emulsion as above.

4. Dissolve six pounds of soft soap in boiling water, then add five pints of linseed oil, continually stirring until a good emulsion is obtained. Dilute as above.

5. Ten pounds of soap chips are dissolved in boiling water, then add four gallons of neatsfoot oil and ten pounds of egg yolk. Stir thoroughly and dilute as above.

6. Fifteen parts of olive oil soap are emulsified with four and one-half parts of olive oil, and diluted as above.

7. For fancy shades Professor Procter recommends the following fat-liquor: Half per cent. castor oil soap or olive oil soap and three-fourths per cent. castor oil are stirred together until properly emulsified, and then diluted with hot water.

8. This fat-liquor is recommended by Jettmar: Three pounds of castor oil soap, two and one-half pounds of glycerine, one and one-half pounds of castor oil emulsified with ten pints of boiling water.

These receipts will prove sufficient for all wants; and a practical man should, by using them or by varying the quantities of the ingredients to suit his individual purpose, be able to turn out a good quality leather with them.

After drumming for about thirty minutes, the skins will have absorbed the whole of the fat, and the remaining liquor should be quite clear. They are then taken out of the drum, horsed and allowed to hang for a time to give the fat-liquor a chance to settle well into them. After this they are rinsed off in warm water, struck out, oiled and hung up to dry.

CHROME ALUM TANNING LIQUORS.

A one-bath chrome tanning liquor that produces fine full leather with a smooth grain is made in the following manner:

Dissolve ten parts of chrome alum in sufficient water and allow the solution to cool. In another vessel dissolve three parts soda in warm water. Add sufficient of the soda solution to the chrome alum liquor until a permanent precipitate is just dissolved and a clear liquor is obtained. With this solution make a fairly weak tanning bath to start with and, after

the skins have been in the liquor two or three hours, add more of the chrome solution, continuing to add liquor to the bath at short intervals, until they are struck through with the green liquor. The old tanning bath may be used for a fresh lot of skins, and a new bath then made into which the second lot of them is placed when the first bath is used up, and so on. When tanned, the skins should be washed in a two per cent. borax bath and then in clean water until the superfluous acid is neutralized.

Another very simple tanning liquor is made of chrome alum, soda and salt. Take ten per cent. of the weight of the skins of chrome alum (ten pounds of chrome alum for one hundred pounds of skins) and dissolve it in sufficient water, then dissolve separately two and a half to three and a half per cent. of soda.

Add the soda solution to the chrome alum until a permanent precipitate of chrome oxyhydrate begins to form, and then a small quantity of common salt. This simple tanning liquor is used quite extensively in Europe.

ANOTHER FORMULA.

Dissolve fifty pounds of chrome alum crystals in ten gallons of water. In another vessel dissolve twenty-five pounds of carbonate of soda in ten gallons of water. Also dissolve twelve pounds of chromic acid in six gallons of hydrochloric acid. When all is dissolved mix in a fifty-gallon barrel, first the chrome alum, then the soda, and lastly the chromic acid. Stir well and fill the barrel up with water to make forty-eight gallons. This will tan eight hundred pounds of pickled skins.

Dissolve by boiling in fifteen gallons of water six pounds of sulphate of alumina. In another tub dissolve by boiling in fifteen gallons of water six pounds of sal soda. Pour the latter solution slowly and with constant stirring into the alumina solution and let the mixture stand over night. The two solutions combined form a milky-white liquor.

Weigh the pack of skins to be tanned and put it into the tanning drum. For every hundred pounds of skins put ten

pounds of salt and five gallons of water into the drum, start the drum and run it fifteen minutes. Heat three gallons of the alumina soda liquor for each hundred pounds of skins to 80 degrees Fahr. and pour it into the drum. Drum the stock in the liquor thirty minutes, then begin to add the chrome liquor. Six gallons of the tan liquor will tan one hundred pounds of skins. Pour one gallon into the drum at a time at intervals of one-half hour, and drum eight hours in all. Let the skins remain in the liquor over night, then wash, shave, color and fat-liquor them. If the stock is heavy and is to be split and shaved after it is tanned, use four gallons of tan liquor and tan five hours, then split and shave it, and next retan with three gallons of tan liquor for each hundred pounds of leather. When re-tanned, wash the leather, using one pound of borax dissolved in three gallons of warm water for each hundred pounds of it. Wash in this one-half hour, then wash it in cold water for one hour, or until perfectly clean, when it is ready to be colored.

Chrome alum should be dissolved in cold water, stirring constantly. A good way to dissolve it is to use the revolving drum, which hastens solution. The addition of common salt to a chrome alum solution converts it into chromium chloride. The use of chrome alum, soda and salt is the cheapest way to make a chrome liquor.

A liquor for one hundred and twenty pounds of skins may be made as follows: Thirteen pounds of chrome alum are dissolved in thirteen quarts of water at 65 to 70 degrees Fahr.; to this solution are added two and one-half pounds of common salt dissolved in a gallon of warm water. In another vessel four and a half pounds of sal soda are dissolved in three gallons of warm water. The sal soda solution is slowly added to the chrome alum solution until the liquor begins to get cloudy, which indicates that the chrome alum is nearly neutralized and the liquor is basic. Chrome leather becomes fuller and finer the more nearly the chrome alum solution approaches the point of precipitation. Salt tends to give the leather a soft feel, and the grain a fine break, and soda tends to give fulness. When no

salt is employed the leather is hard and tight, lacking in elasticity. Using the liquor at 85 degrees Fahr. hastens the tanning and produces a soft leather. Enough liquor fed slowly to the stock must always be used, so as not to close the pores and prevent penetration. The skins are tanned when a cutting shows a blue-green color clear through and a white fiber when the leather is scraped with a knife. Fully tanned chrome leather will stand boiling, while imperfectly tanned skins will not. Overtanning is as bad in one way as undertanning is in another. The former weakens the fiber of the leather and makes the skins too soft and spongy; the latter results in hard, tight leather that will not carry grease and that cannot be properly finished.

TO PREVENT COLORED LEATHER FROM FADING.

A dressing of borax and shellac is said to prevent the color of furniture and other leather from fading. It is made as follows: Boil one ounce of borax in three quarts of water and add, while it is boiling, one and one-half ounces of shellac and just enough aniline dye of the same color as the leather to match the shade. The mixture is then allowed to cool and is ready for use. This dressing should be applied to the leather with a soft sponge, slowly and with care, to prevent streaks. Care must be taken, too, in selecting the shade to correspond with the color of the leather. After the dressing has been applied the leather should be hung up by the neck, grain side out, to dry. When dry it should be rubbed lightly with a soft woollen cloth or brushed over a felt wheel. This dressing does not affect the character of the leather, but the correct proportions of ingredients must be used, as if made stronger the mixture is apt to make the grain brittle. The leather should be well brushed, and if dirty washed with warm water, if possible, before the dressing is applied.

A dressing made of casein and ammonia is also said to be effective in preventing the fading of colored leather. Boil a pint of water. As soon as it begins to boil add half a pint of spirit

of ammonia, and then dissolve in it about two ounces of casein. Stir the mixture well until solution is complete, and then dilute with water to about six quarts. This dressing can be applied at once to the leather after coloring, while still moist, evenly and lightly until it penetrates. If the leather is dry the dressing must be laid on still more lightly. This solution of casein can also be applied to made-up articles, such as saddlery. The leather should be clean before the dressing is applied, and then dried in a warm room and rubbed with a soft woolen cloth.

BLACK FOR WAX CALF, KIP, UPPER AND SPLITS.

This black can be used on all kinds of wax stock, such as calf, kip, upper and flesh or grain splits. It produces a very close foundation for a fine wax finish:

Six pounds of French velvet-black, three pounds of castile soap, two pounds of common soap, four pounds of tallow, five gallons of cod oil, one gallon of raw linseed oil, one pound of beeswax, one beef gall.

Put the black in a keg together with the cod oil on top of the black, cover it over night, next boil the soap in about three pailfuls of water until dissolved; then add the tallow. Keep the whole boiling. Then add the black that has stood with the oil over night and stir it thoroughly to get it well mixed. Add the beeswax, beef gall and linseed oil. Stir well, and while boiling slowly add seven pailfuls of water, pailful after pailful. After it is all well boiled cover it over with a bag and stir it every two hours the first day. Next morning stir a couple of times; it is then ready for use.

This dressing produces a beautiful deep black and gives a close, fine appearance to any fiber to which it may be applied.

HOW TO PREPARE SIDE LEATHER OR SKINS FOR BLACKING AND FOR YELLOW-BACKING KANGAROO.

After the leather is stuffed and comes from the dry loft put it into the drum. For one hundred skins or eighty kips or seventy sides use four pounds of turmeric, three pounds of soap

and three pounds of Wyandotte Tanner's Soda. Dissolve the soap and soda in one-half barrellful of water. Then thoroughly dissolve the turmeric or auramine, which is occasionally used by some tanners, and add it to the soda and soap solution, making of it three-quarters of a barrellful. Pour this liquor into the drum and run for twenty minutes, after which, if desired, the leather may be treated with sumac. It is then ready to be blacked. Some tanners do not dry the leather after stuffing, but put it in piles for six hours, then put it in a drum and color the flesh yellow.

BLACKING FOR HARNESS LEATHER, KANGAROO LEATHER,
CHROME LEATHER AND OTHER BLACK STOCK.

Dissolve two and one-half gallons of copperas in fifty gallons of water. When thoroughly dissolved add from three to four pounds of Wyandotte Tanner's Soda to the copperas solution, stirring thoroughly while the soda is being added. The soda neutralizes the sulphuric acid that is in the copperas, thus producing an iron-black. Let the solution stand for forty-eight hours. Do not stir, as there will be a sediment which will settle in the bottom of the barrel which should not be used. Before using this solution skim off any scum that may have formed on the surface. Then dissolve five pounds of nigrosine in about twenty gallons of water. Add the copperas solution to the nigrosine solution in quantities for immediate use only. Care should be taken not to make this solution too strong, as it may smut the leather. This blacking may be applied to any stock upon which it is customary to use logwood or copperas.

APPENDIX.

VARIOUS PATENTS RELATING TO TANNING, WITH SPECIFICATIONS.

COLORING CHROME LEATHER WITH PERMANGANATE OF POTASH.

THE process of coloring leather with permanganate of potash, as described below, is a new and patented one. By its use, it is claimed, coloring can be economically effected and deep, rich and permanent shades of black obtained. Although this process is practicable for hides and skins of all descriptions, it is here described as used on chrome-tanned goatskins. Other leathers may be colored in the same manner with such changes in the quantity of materials employed, and in the manipulations as their different sizes and characters would require.

In a suitable coloring drum are placed, say, four hundred and fifty pounds of skins as they come from the shaving machines, together with thirty gallons of warm water, and the drum is then closed. Now dissolve two and a half pounds of permanganate of potash in forty-five gallons of warm water, and after adding to the solution two and one-half pounds of muriatic acid, 21 degrees Baumé, pour it into the drum through the gudgeon. Run the drum ten minutes, then stop it and allow the liquor which is now spent to run off. Close the drum again and allow it to rotate, and add as before, through the gudgeon, two gallons of iron liquor which has been mixed with forty-five gallons of warm water. After the drum has run ten minutes stop it and allow the spent liquor to run off. Next dissolve in forty-five gallons of warm water three pounds of extract of logwood or other suitable vegetable extract and three pounds of sal soda, and after the drum has been closed and started to rotating add the logwood and soda liquor by pouring it through the gudgeon. After ten minutes stop the drum, open it and remove the skins. The coloring process is now complete and the skins should be washed thoroughly, preferably in a turster, with warm water for twenty minutes, then fat-liquored and finished. The iron liquor referred to above may be prepared by dissolving scrap iron in dilute commercial acetic acid, and the solution when ready for use should show 10 degrees Baumé. But any suitable ferrous salt may be used. The temperature of the warm water referred to above should be

about 110 degrees Fahr. in summer, and from 120 degrees to 125 degrees Fahr. in winter.

Muriatic acid must never be added to a hot concentrated solution of permanganate of potash, as this would result in the evolution of chlorine and the formation of manganous chloride, which is not the salt of manganese desired. The muriatic acid is added to the permanganate solution when all the required quantity of water is present. As an acidulated solution of permanganate of potash strikes very quickly on leather, there must be a sufficient amount of water present in the drum to secure even distribution over it. Skins that have not been washed clean from the hypo bath should have the requisite amount of acid added to the first thirty gallons of water referred to. The permanganate dissolved in water is added after an interval of about five minutes.

To determine whether a sufficient amount of permanganate has been used, throw a skin over a horse exposed to the sunlight and observe after an interval of fifteen or twenty minutes whether or not the brown color is uniform and even. If light streaks or spots develop it is evidence that the sulphurous acid in the leather has not entirely neutralized. Such leather should have more permanganate, but it must always be borne in mind that permanganate of potash is a powerful oxidizing agent, and can be safely employed only in very dilute solutions.

On bark and vegetable-tanned leather weaker solutions of permanganate than those above prescribed for chrome leather should be used. When chrome-tanned skins are treated with an acidulated solution of permanganate of potash all of the latter quickly combines with the leather, imparting to it a brown color. It is to some extent reduced by the leather itself, and it thoroughly destroys any sulphurous acid present that has been carried over from the hypo bath. Following this with a ferrous salt, all the remaining permanganate compound is reduced to an insoluble modification, and the ferrous salt is oxidized to a ferric state and is at once absorbed by the stock. The final treatment with logwood and soda forms a perfectly insoluble and permanent jet black which will last as long as the leather itself.

The function of the soda is not merely to assist in the formation of the color-lake by neutralizing the acid liberated from the iron liquor, but it is necessary to have sufficient alkali present to neutralize all of the acid in the stock which has been taken up from previous steps of the process, as well as any acid carried over from the hypo bath. The leather should be neutral, or only very slightly, but never very, alkaline. After this treatment it can be washed perfectly clean, it being placed in a drum and not removed until all the coloring operations are completed, saving thus much handling and labor.

Only very small quantities of the chemicals used are required for a large number of skins, which makes the process not only a very economical one, effecting a considerable saving over present methods, but also secures the softest possible method of applying coloring materials, as the grain is never in the least roughened or contracted.

The stock being thoroughly washed and cleaned before staining and fat-liquoring, and all sulphurous acid being eliminated, there is no chance for skins colored by this method showing any bloom or spew when finished.

The remarkably fine, smooth, silky feel which permanganate of potash imparts to leather is retained and emphasized by the subsequent treatment. It is also claimed that stock colored by this process will glaze much brighter and have a superior finish, more permanent and lasting, than when colored by any other method.

In working this process the inventor found that the best results were obtained by using the quantities of the materials and the manipulations specified, but he does not confine himself either to these proportions or to these methods of manipulation, as considerable modifications can be made without departing from the essential features of the process. It is patented by William M. Norris, of Princeton, N. J.

THE USE OF PERMANGANATE OF POTASH IN COLORING LEATHER.

One important advantage gained from the use of permanganate of potash is that about one-half the quantity of logwood liquor usually employed will be found sufficient. This effects a considerable saving.

The beneficial effects of permanganate of potash to chrome-tanned goatskins intended for glazed kid must be apparent to those who have given it a careful trial. The question is how to apply it with the least trouble and labor to produce the best results. Either of two methods may be followed.

1st. In a reel containing six hundred and fifty gallons of water add five pounds of permanganate of potash, which has been previously dissolved in a little hot water. The temperature of the bath should be about 110 degrees Fahr. The skins upon coming from the tanning liquors are thoroughly washed and are then entered into the above bath. After remaining in the bath, with the paddles revolving, for about thirty minutes, the stock is removed, horsed up for twenty or thirty minutes, and the usual operations of staining, fat-liquoring and coloring may now be proceeded with in the ordinary manner. This treatment with permanganate of potash kills all traces of sulphurous acid in the skins, therefore it is not necessary to use alkalies, such as soda or borax, in the water in which they are washed from the reducing bath, as is generally the practice. Or the permanganate may be applied to the stock in this manner :

2d. After tanning, wash the skins, stain and fat-liquor them in the usual manner. They are then smoothed out with a slicker, and, after being folded, grain side out, each skin is dipped into a bath consisting of a solution of permanganate of potash, which is prepared in the following manner : Five pounds of permanganate of potash are dissolved in thirty gallons of water to form a stock solution. Of this stock solution one gallon is mixed with twelve gallons of water, which forms a bath capable of treating one hundred pounds of skins. In preparing

the bath in the first instance the percentage of permanganate solution may be increased to about two gallons ; but after treating the first batch of skins an addition of one gallon of the solution for each subsequent batch of one hundred pounds of skins will be sufficient to maintain the bath at the proper strength. After allowing the stock to be drained well the final coloring may then be proceeded with in the ordinary manner, except that one-half the usual quantity of logwood liquor will be sufficient. If the permanganate does not appear to strike evenly, and the stock shows any indications of spots, streaks or teeth, a little salts of tartar should be added to the bath ; or the stock solution may be prepared by dissolving five pounds of permanganate and two and one-half pounds of salts of tartar in thirty gallons of water. The workmen who dip the stock in the permanganate liquor should wear rubber gloves.

The advantages resulting from this process are that a fine base or foundation for the color is formed ; the grain of the leather appears smoothed down ; all roughness, stringiness, beardiness are lessened, and presenting when glazed a smooth, fine, unctuous feel, a brilliant, lustrous color and a high, clear finish.

The methods employed in coloring the skins, after they have been treated with permanganate of potash, vary, depending upon the color or the shade that is desired. Skins treated with permanganate of potash may be colored any shade of color. For tan shades the preliminary treatment may be with a solution of tanning material, such as sumac or gambier, and after this has been applied the permanganate of potash is put on, and this is followed by an application of aniline dye of the desired shade. By subjecting skins to this treatment more permanent and uniform results are obtained. The process is applicable to stock tanned by the use of alum, bark or other materials, as well as to chrome-tanned skins. It has been used in practice, however, mostly upon goatskins intended for glazed kid.

This process is patented by W. N. Norris, Princeton, N. J.

LEATHER FOR PNEUMATIC TIRES AND OTHER SPECIAL PURPOSES.

The object of this invention is to produce a leather which will be exceedingly tough and flexible yet inexpensive to produce, while at the same time it will be adapted to many purposes to which ordinary leather is inapplicable, and more particularly as an armor for pneumatic tires. For this purpose any suitable hide, such as ox hide or cow hide, is employed, and submitted to the following treatment :

The raw hide as taken from the animal is soaked in clean water for a period of three to seven days, then fleshed, that is to say, loose pieces of flesh and grease are removed from the flesh side, after which it is placed in a pit with a solution of lime and water for a similar period, and by this process it is reduced to a gelatinous condition. It is then taken out and unhaired and next laid in a pit containing a mix-

ture of alum and egg or other suitable albumen for four to ten days, after which it is in condition to be chemically treated.

The alum and egg albumen mixture is composed of 56 pounds of alum, 4 pounds of egg albumen and 150 gallons of water, and the hide is soaked in this for about four days or longer, as circumstances may require. It is then successively placed in each of a series of chemical soaks or baths of graduated strengths, commencing with the weakest, each soak consisting of a combination of sulphuric acid, red arsenic and sumac liquor in suitable proportions. This soaking is continued for about two days, during which period the hide is changed every twelve hours from one soak to another of the next higher gradation as regards strength, after which it is placed in a soak or bath consisting of a solution of rubber, petroleum benzine and naphtha, for about two days. It is then taken out, strained on stretchers or frames and air-dried, after which the leather is ready for use. The best way to deal with this part of the process is to soak the hide in the benzine and naphtha and afterward to work or knead into it a solution of rubber.

Thus treated it retains all its natural fibrous and other qualities, has nearly the same flexibility as rubber, is entirely free from grease, so that it will readily receive rubber solution, and is practically impenetrable with ordinary usage.

In treating, say, twenty-five hides the following proportions may be employed for the principal baths or soaks:

The Sumac Soaks.—No. 1. 150 gallons of water, $\frac{1}{2}$ pint of sulphuric acid (specific gravity 1.840), 3 pounds of red arsenic, 1 cwt. of sumac.

No. 2. 150 gallons of water, 3 quarts of sulphuric acid, 4 pounds of red arsenic, $1\frac{1}{4}$ cwt. of sumac.

No. 3. 150 gallons of water, 6 quarts of sulphuric acid, 5 pounds of red arsenic, $1\frac{1}{2}$ cwt. of sumac.

The Benzine Soak.—12 gallons of benzine; 6 gallons of coal tar naphtha; 56 pounds of rubber solution of commerce, consisting of Para rubber 1 pound, coal tar naphtha $\frac{1}{2}$ gallon, benzol 1 pint and carbon bisulphide $\frac{1}{2}$ pint. Or the rubber may be omitted and the hides treated separately.

PNEUMATIC TIRE LEATHER.

A process by which chrome leather can be made to retain its flexibility, acquire resilience and become almost punctureless and self-healing if punctured, has been patented in the United States by Philip Magnus of Collingwood, Victoria. The leather is first cleaned from all impurities or foreign matter, and dried. It is then submerged in a cold bath consisting of benzine, about eighty-five parts; benzol, about ten parts; naphtha, about three parts; kerosene, about five parts. After submersion in such bath for about thirty minutes, the leather is removed, and it is then placed, flesh side up, upon a bench and the solution worked in with a wire or bristle brush. After the first solution has, by the aid of a brush, been caused to penetrate the leather, it is

again submerged for a few minutes and brushed. It is again dipped and brushed and then hung up to allow the mixture that has not been absorbed to drip off or evaporate.

The leather is then ready for further treatment by immersion in baths made of the following mixture : Para rubber, about twenty parts ; benzine, about eighty parts ; benzol, about ten parts ; naphtha, about two parts ; isinglass, about one part. The shredded rubber is first dissolved in the benzine, then the benzol and naphtha are added, and finally the isinglass, previously dissolved in enough hot water to form a thick, gelatinous solution. The solution of rubber, benzine, benzol and naphtha is divided into three equal parts or baths. One of the portions is the "thick" bath. To the second portion add, say, ten parts more of benzine and a fractional (one-eighth) part of naphtha, and call this the "thin" bath ; and to the third bath add ten parts of benzine and one-eighth part of naphtha more than added to the second bath and call this the "thinner" bath.

The leather is then treated successively in these baths, being immersed in the thick solution or bath about four hours, in the thin bath about seven days, and in the thinner bath about four days. After each bath the liquid is worked into the leather with a brush, as above described, and hung up to allow any free liquid to escape by dripping and evaporation. The isinglass mentioned is the purest natural gelatine known, and imparts to the latter a soft, tenacious quality. It is dissolved in sufficient hot water to render it gelatinous, as before mentioned, and then is incorporated with the rubber, benzine and naphtha by mechanical mixture so as to be applied to the leather at the same time therewith.

The leather is finally treated with a third mixture consisting of benzine, about seventy-five parts ; benzol, about twenty parts ; naphtha, about one part ; kerosene, about five parts, rubbed in with the aid of a stiff brush, after which treatment it is hung up and thoroughly dried.

TANNING WITH CATECHU, SEPTFOIL ROOT, ALEPPO GALLS, HOPS AND GUM SENEGAL.

The object of this invention is to provide a tanning liquor which shall in a ready, rapid and economical manner be adapted, to tan hides and skins, and the ingredients of which are such as can be readily procured in almost any locality, and requiring no special machinery or apparatus for the preparation of the mixture. In carrying the process into effect, soft water ten gallons ; Bengal catechu, one-quarter of a pound ; septfoil root (*Potentilla tormentilla*), three pounds ; aleppo-galls, one-half pound ; ground hops, one-quarter of a pound ; and powdered gum senegal, one-fourth ounce, are used.

All of the ingredients with the exception of the gum senegal, are placed in the water, and the latter is brought to and retained at the boiling-point for one hour or more. It is then allowed to cool, when the gum senegal is added and thoroughly stirred into the liquor.

In using the bath, the hides or skins are allowed to remain therein from two to seventeen days, according to their character; and when the necessary period has elapsed, the stock will be found to be thoroughly tanned. The usual washing and treatment with oil may be employed if deemed necessary or desirable. This process is patented by George A. Sweetman.

TANNING WITH HORSE-CHESTNUT AND POKE-ROOT EXTRACTS AND
GAMBIER.

By means of this tanning compound, it is claimed that hides and skins can be readily, cheaply and quickly tanned into leather.

The compound consists of :

Extract of buckeye or horse-chestnut	1 pound.
Extract of poke-root	2 pounds.
Gambier	12 pounds.
Water	20 gallons.

Make the extract of buckeye or horse-chestnut by boiling twelve pounds of horse-chestnut bark in six gallons of water for about two hours. Make the extract of poke-root by boiling eight pounds of poke-root in three gallons of water for about one and a half hours. Hides after they have been unhaired and otherwise prepared are placed in this tanning compound and kept therein for a suitable length of time. Where the hide is light, it is usually necessary to keep it in the compound for twenty-four to forty-eight hours. Ordinarily upper leather requires to remain in it for from five to six days. Heavy harness and sole leather requires usually from ten to fifteen days. The tanner by observing the color of the hide, can determine when it has been sufficiently tanned. This compound is patented by George W. Langley.

LEATHER FOR ORGAN PIPES.

Leather made by the following process is distinguished by its fineness, suppleness, lightness and durability, such properties being required for many industrial purposes, particularly for lining organ pipes and in the manufacture of bellows and the like, and generally for purposes where it is desired to have an air-tight, light and flexible material. The leather hitherto used for such purposes was usually not absolutely air-tight or sufficiently flexible, while rubber sheets or fabrics impregnated with a solution of rubber, although air-tight, are very difficult to fit snugly by reason of lack of softness. They have besides the serious drawback of being liable to deteriorate and lose their flexibility, thereby becoming brittle under the influence of cold. This is of great importance in the case of organs in churches which are not heated during the winter. This leather obviates all these drawbacks and is therefore suitable for various purposes. It is manufactured from the outside wall of the intestinal tube, more particularly from the caecum or blind gut of

the animal. This outermost skin of the blind gut has hitherto been deprived of its fat and dried, and used as the so-called "goldbeater's skin." It has been proposed to subject it to a tanning process, but the leather obtained in that way alone is not sufficiently air-tight and durable.

According to this process the blind gut skin, well cleaned and washed with potash or the like, is first tanned by means of mineral substances, such as chrome alum, etc., or with vegetable substances. In practice it has been found that for two hundred skins of the maximum size four hundred grams zinc sulphate with ten liters of water is suitable as a tanning solution, or about the same quantity of chrome alum may be used. The skin is then placed in a filling bath of yolks of eggs, flour or the like, permitted to remain until thoroughly impregnated, whereby it is made thicker and stronger. This bath is preferably made by adding to about one liter of yolk of eggs a small quantity of flour. By this filling process the skins absorb the oil of the eggs. After rinsing they are stretched and dried. This drying is effected by placing two skins one on top of another and allowing them to dry together in intimate contact. During this drying process they firmly adhere to each other without any gluing or cementing material being used. The best plan is to place the grain, or outermost, sides of the two skins against each other. More than two skins may be superposed, in which case the similar sides are placed in apposition.

When a multiple skin treated in this manner has become sufficiently dry it is degreased or deprived of its fat by treating it with benzine, it being at the same time rubbed and kneaded in it, whereby it is rendered soft and supple. This treatment is necessary to remove the oil incorporated in the skin by the treatment with the eggs and to render the leather soft, pliable and capable of being cemented to wood and other materials. This property renders it suitable for gluing or piecing together, so that large pieces of any size may be made from small pieces of it, and it can be cemented to other materials, such as wood, etc., which is of importance for organ pipes and other purposes.

The process, as stated, includes the process of tanning of the stock, but if untanned skins are subjected to the other steps of the treatment—filling, superposing and washing with benzine—a product is obtained having many advantageous characteristics over the untanned skins previously known.

Bruno Trenckmann, of Schöneberg, near Berlin, Germany, assignor to Zephyrlederfabrik Gesellschaft Mit Beschränkter Haftung Vormals Trenckmann & Co., has a United States patent on the above-described process.

COAL TAR IN SOLE AND HEAVY UPPER LEATHER.

This process consists in treating leather with coal tar whereby it is, without impairment of strength and flexibility, rendered absolutely waterproof, and its durability enhanced. The operator prepares a bath

of coal tar having a temperature of approximately 110 degrees Fahr., and immerses therein leather that has been tanned by the usual method and that may be in a split or unsplit condition, and either before or after the rolling and glossing processes have been employed to fit the material as to weight or density, according to its intended use. The leather is kept immersed in the bath at the above-mentioned temperature for a period of time ranging from twenty-four hours to six days, according to its density or thickness or the use for which it is intended, during which time it becomes thoroughly saturated or impregnated with the coal-tar. It is then removed from the bath and is passed between rollers exerting pressure to express the superfluous tar and to force the retained tar into all the fibers. The rolled leather is then placed upon drying-racks and, when nearly dry, it is again passed between pressure-rollers and if desired is glossed in the usual manner. It is advisable in case of heavy tar to add a small quantity of gasoline or the like to reduce the weight and assist absorption, which is accomplished by capillary action. The absorbed coal-tar is thoroughly incorporated with the fibers; and in drying the leather becomes a compact gutta-percha-like material, having a high wear-resisting quality compared with leather that has not been so treated. Moreover, it is claimed that leather treated by this process retains its strength and flexibility, is antiseptic and vermin-proof and will not become impaired by long exposure to water. Patented by Loftus Harley Francis, of Princeton, Cal.

TANNING WITH TERRA JAPONICA, ALUM, GAMBIE AND EXTRACT OF
CRANE'S BILL.

This tanning compound is composed of terra japonica, fluid extract of crane's bill, alum and a coloring material, the latter for hides being preferably gum gambier.

The proportions of the ingredients will vary according to the nature and age of the hide or skin and the length of time the same is to remain in the bath. The following proportions are given for approximately five gallons of water in the preparation of a bath for one or two year old calf hides :

Terra japonica.....	2 pounds.
Gum gambier	2 pounds.
Alum	1½ pounds.
Fluid extract crane's bill	1½ ounces.

The ingredients are mixed and the hide, after being limed, depilated and bated, is immersed in the solution until thoroughly tanned.

For skins and small hides, the proportions will be less, and for cow, ox and horse hides they will have to be increased. For example, the skin of a yearling is readily tanned in a comparatively weak tanning-solution, whereas the hide of a bull requires a longer time and a tanning solution of greater strength.

Horace M. Murray, of Seligman, Mo., assignor to J. W. Dodgen, of Oak Grove, Ark., is the patentee of the compound described above.

TANNING WITH GAMBIER, BLACKBERRY ROOTS AND WITCH HAZEL.

The composition of the tanning compound of this process consists of the following ingredients in about the proportions given, viz., extract of gambier, five pounds; decoction of blackberry roots, one-eighth of an ounce; decoction of witch hazel, one-eighth ounce; water, six gallons. It is prepared by adding to the gambier only sufficient water to dissolve it. Then to each six gallons of soft water add five pounds of the gambier solution, one-eighth of an ounce of the decoction of witch hazel and one-eighth of an ounce of the decoction of blackberry roots. These substances are thoroughly mixed and a sufficient quantity of the tanning composition is placed in a vat to act on the hides placed therein, their size, age, thickness and number determining the quantity of the composition to be used. Hides are thoroughly tanned in from four hours to eight days, the length of time depending upon their age and thickness.

The decoction of witch hazel is prepared by taking, for example, one pound of the bark as it comes from the tree, placing it in two gallons of water and boiling it for two hours in a closed vessel, and then straining the liquor. The resultant decoction will measure somewhere between a pint and a quart, the variation being due to the character of the boiling, that is to say, whether it be hard or gentle.

The decoction of blackberry roots is produced by taking, for example, one pound of the roots as they come from the ground, placing it in two gallons of water, boiling for two hours in a closed vessel and then straining. The resultant decoction will measure between a pint and a quart, the variation being due to the character of the boiling, whether it be hard or gentle. The decoctions thus obtained are added to a quantity of water containing a solution of from one and a half to five pounds of gambier, the amount of gambier depending upon the quantity of water required to cover the hide, color and set the grain, care being taken to have the two decoctions thoroughly mixed with the gambier solution. The hide will remain submerged in the ooze for from four hours to eight days, the length of time depending on its age and thickness.

After it has been submerged the required length of time in the ooze formed by the ingredients, it is removed and thoroughly washed with water and then treated with fish oil. These operations remove any tannic acid present. Patented by Sherman Brown.

UTILIZING SPENT TANNING LIQUORS TO INCREASE THE WEIGHT OF LEATHER.

The object of this invention is to produce a liquid dressing particularly applicable to the manufacture of sole leather, which is to have the greatest degree of solidity possible with the necessary degree of flexibility. All processes for making such leather have heretofore involved two stages: First, the hides are subjected to the action of a liquor comprising active tannic material until combined with all of the tannin

with which they are capable of combining, and second, the leather thus tanned is then subjected to a loading process, which usually consists in filling it with concentrated bark extract.

This improved process is advantageous in that sapped or exhausted organic tanning liquors, which are usually wasted, are thereby utilized to form an inert leather dressing which is an efficient substitute for the more costly active tannic material heretofore employed for loading purposes. In order to make such leather dressing, it is necessary to eliminate such impurities as have accrued in the liquors from the addition of chemicals thereto or the formation of chemical compounds therein. If the waste liquor is from an acid-tanning yard and contains sulphuric or other non-volatile mineral acids, it may be neutralized by the addition of alkali, or the acids may be precipitated as salts by the addition of suitable reagents. On the other hand, if the waste liquor is from a non-acid yard and contains lime or lime compounds, such impurities in accordance with this process may be precipitated by the addition of chemicals forming insoluble compounds with lime. For instance, ammonium oxalate, sodium phosphate, sodium fluoride or carbon dioxide gas may be employed to effect such precipitation. The spent liquor may then be heated until the volatile impurities, for instance, acetic, propionic or butyric acids, are eliminated, and the resultant liquor is concentrated conveniently by continued heating in vacuo until it attains a specific gravity of from 1.05 to 1.3 and becomes a leather dressing adapted for the purposes specified. The otherwise waste liquors thus purified and concentrated may be utilized as a dressing to increase the solidity of leather, as follows: Hides which have been subjected to the action of a tanning solution until they have combined with approximately all the tannin with which they will combine, are then impregnated with the leather dressing in any convenient manner. It may, for instance, be placed in a rotary drum and the concentrate, preferably heated, introduced into the latter, conveniently through a hollow axle or trunnion thereof, and the revolution of the drum continued until it is absorbed by the leather and fills the pores of it, so that when dried the residue of the dressing in the leather not only renders the latter more solid than if it had not been impregnated, but also adds materially to its final weight. It may be observed that if the dressing were of less specific gravity there would not be sufficient solid residue when the leather dried to effect the result desired. Moreover, if the dressing were of a greater specific gravity it would not be absorbed by the leather. Patented by George W. Childs.

A NEW PROCESS OF TANNING WITH METALLIC SALTS.

A patent has recently been issued in Germany for a process of tanning with metallic salts, in which the hides or skins are impregnated with a solution of basic sesquioxide and afterwards treated with an alkaline solution of a sesquioxide or of a metallic oxide.

The methods hitherto in use in both chrome and white tanning had for their object the combination of a metallic oxide or basic oxide with the animal tissue. In chrome tanning, if the effect depends upon the reduction of chromic acid in the presence of the animal tissue or the action of strongly neutralized sesquioxide of chrome depends upon the latter, then the tanning principle must be looked for in the chrome combination, and in white tanning in a combination of aluminum.

In dyeing, the fact has been noted that when metallic sesquioxides are employed as mordants their effect is greatly increased in combination with metallic oxides, whose action alone as mordants is *nil*. Experiments as to the effect of these combined mordants in mineral tanning have shown the surprising result of a particularly firm and solid leather, giving besides the important advantage of making it possible to obtain remarkably fine colors, especially with solid mordant colors. For instance, the skins are first tanned with a basic oxide of chrome salt and afterwards treated with a solution of oxide of zinc and sodium. The basic chrome salt loses through the sodium its last trace of acid, and thus deprived of its solvent the chrome must be precipitated, and in intimate combination with it the zinc oxide which had been held in solution by the soda. By this means not only a more complete and better utilization of the chrome oxide is secured, but also an intimate combination and strengthening with the oxide of zinc, which takes a stronger hold on the fibers of the skin than the simple oxide. Of course the oxide of zinc and sodium can be replaced with other analogous compounds, such as aluminate of sodium, oxide of copper and ammonium, etc.

The practical sequence of the process is as follows: The skins, prepared as usual, are placed in a bath of chloride of chrome of about 1 degree Bé. strength. This bath is increased at regular intervals by one-half degree until it reaches 3 degrees Bé. in strength. As soon as a cutting from the skins shows that they are fully tanned, they are removed and placed in a bath of oxide of zinc and sodium of from 2 to 4 degrees Bé. strength. They are afterwards thoroughly washed and finished in the usual manner.

TANNING WITH POKE-ROOT, ALUM AND GAMBIE.

The hides or skins are unhaired with lime, then washed and bated in the usual manner. They are next placed in a bath in the proportion of four gallons of water, which has been boiled, to a quarter of an ounce of fluid extract of *phytolacca* or poke-root, and after being agitated therein, four pounds of gambier are added to the bath and stirred until thoroughly dissolved, after which one pound of pulverized alum is added and dissolved. The hides or skins after being dipped several times in this liquor are allowed to remain in it until tanned, which requires from two to twelve days. When tanned they are removed, rinsed in clear water and treated with fish oil and dried. The leather can then be

finished and curried in any manner. Patented by Ira D. Burrows, of Poolville, Texas.

PROCESS OF MAKING LEATHER FOR FURNITURE, UPHOLSTERY, CARRIAGES
AND AUTOMOBILES.

The objects aimed at by the inventor of this process are the production of a finished leather which will possess great durability, freedom from cracking and other objections and which will be cheap to manufacture. These objects are attained by coating the leather with a number of coatings, the inner coating or coatings being elastic, at least one of them containing a relatively large proportion of non-drying oil or oil not readily oxidizable and soluble nitro-cellulose, which is preferably in solution with amyl acetate and diluted with alcohol. The innermost coating is preferably formed by making a portion of the diluent of alcohol, which by its quick evaporation will cause the pyroxylin to set before the amyl acetate has an opportunity to penetrate the leather and deposit the pyroxylin on its surface in the form of a thin film. The inner coating or coatings will never entirely dry, owing to the large proportion of non-oxidizing oil employed, and will remain always in a tacky or sticky condition. The outer coating or coatings preferably contain a much larger proportion of pyroxylin and a smaller proportion of oil. The outer coating or coatings will preferably be largely of pyroxylin and will set with a dry surface, which will cover and protect the inner coating or coatings. This outer coating will preferably be very much thinner than the inner coating or coatings.

As a basis, real leather as distinguished from artificial leather is employed. Small skins or large hides may be used; and the process may be applied with success to the less expensive splits as well as to the more expensive grained and buffed leathers. For the oil a non-drying oil is employed, that is, an oil that is not readily oxidizable. As examples of such oils castor oil and peanut oil may be mentioned, both of which are abundant and serve the purpose admirably. Other oils which answer the requirements, however, may also be used. For the nitro-cellulose a nitrated cellulose readily soluble in amyl acetate and methylic alcohol such as pyroxylin or gun cotton is preferable. This nitro-cellulose may be in solution in a solvent proper, such as amyl acetate, or in a solvent mixed with a diluent, as fusel-oil. Together with the oil and the nitro-cellulose, gums or other substances may be used to give body to the coating and pigments or other materials to give color, but they are not necessary.

One way of carrying out the process is as follows: The uncoated leather is first coated with a liquid containing the oil and nitro-cellulose in solution and preferably diluted with alcohol, with or without other materials such as gums or pigments. This inner coating is allowed to set, preferably at the ordinary temperature. The first or inner coating when sufficiently set will not be entirely hard and inflexible, owing to

the presence of the large proportion of non-drying oil, but on the contrary, will be tacky and more or less soft, flexible and elastic. A second coating is then superposed upon it. This outer coating may be like the inner one except that it has a smaller proportion of the oil. In this outer coating a larger proportion of pigment may be used, if desired, than in the inner coating. The outer coating in some instances may contain no oil whatever, the effect of the oil in it being secured by the combination of its nitro-cellulose with a portion of the oil of the inner coating. The idea of the outer coating is to serve as a finish to the inner coating, the latter being always soft and therefore impractical for a leather finish. If desired, a third or other coatings may be added, these coatings being similar to the second ones. The process may be modified by making the second coating or additional coatings, if such be used, similar to the first, with the outside or finish coating similar to the second one above described.

As an example for carrying out the process the following proportions may be employed: For a steer-hide split or cow-hide split of average thickness, for the first coating, a solution of about thirteen pounds of pyroxylin dissolved in about thirteen gallons of a mixture of three parts of wood alcohol and one part of amyl acetate, which is at the rate of one pound of pyroxylin to each gallon of solution. To this are added about seventy-five pounds of castor oil, together with about two pounds of any commercial pigment, depending upon the color desired, ground in about twenty pounds of oil. There is therefore used about ninety-five pounds of oil, so that the oil will be at the rate of about seven and one-third pounds of it to each pound of nitro-cellulose. As an example of coloring pigment for some shades of brown, burnt umber may be used. The inner coating will set and will not permeate the leather to any appreciable extent. One reason why this is possible is the use of wood alcohol in large quantity, so that the composition will not entirely, or much of it, permeate the leather and change the character of the coating from one of great elasticity and ability to stretch to a film formed largely of pyroxylin and incapable of being stretched. Instead of the wood alcohol some other material may be used to prevent permeation of the leather by the solution. For the second coating the same amount of pyroxylin and amyl acetate may be employed, but with a smaller proportion of alcohol, depending upon the weather during the operation, on account of its tendency to absorb moisture and then precipitate pyroxylin. To this are added sixteen pounds of castor oil, being much less than for the first coating.

The amount of alcohol used in the second coating depends upon the weather during the operation. The second coating is in a position to absorb moisture while the first one is covered. Therefore if moisture be absorbed a spotted appearance in the coating results. It is possible to make it without alcohol; but the solution will penetrate too far unless other means be provided to prevent this for the reason that the amyl-acetate dries too slowly. The amount of oil in the inner coating

is regulated by the thickness, texture, stiffness and in some cases by the method of tannage of the leather, and also by the length of fiber on the surface, if the leather is a split. A thick and close-textured leather will require a larger proportion of oil than a thinner one or one in which the texture is more open. In some instances chrome-tanned leather will require a smaller proportion of oil than a bark-tanned product. The hand-buffed and the machine-buffed leathers will require a smaller proportion of oil than the split referred to, assuming the proportions to be the same in both cases. The proportion of oil to nitro-cellulose should be varied when used in connection with other leathers, such as goatskin, calfskin, etc., according to the above rule. The proportion may vary from seven and one-half pounds of oil to each pound of nitro-cellulose or even slightly more in some leathers down to very much less in others. It may not well be reduced, however, below three and one-fourth pounds to each pound of nitro-cellulose. This proportion of oil, it is to be understood, is to be measured by the amount of nitro-cellulose employed and does not in any way depend upon the amount of solution containing the nitro-cellulose.

The proportion of oil in the outer coating will vary according to the results desired. A smaller proportion of oil will give a leather having a drier feel. Similarly a larger proportion of oil will give a product with an increased sleekness of feel. The amount of pigment added should be sufficient to secure the desired depth of color. The proportions used will vary according to the results desired. The addition of gums or other oils may cause a slight reduction of non-drying oil. For instance, in connection with the example before given, if a gum or similar substance, such as camphor, is used, and which is soluble in the solvent employed to dissolve the pyroxylin without acting on it, it would be in the proportion of about three-quarters of a pound to each pound of castor oil used.

After the leather is coated, it may be further finished by graining, embossing or pebbling in the usual way.

The leather produced by this process possesses remarkable durability and freedom from splitting or cracking. It is particularly applicable for furniture, upholstery or for use upon carriages and automobiles, and in the construction of folding hoods or tops of carriages. In these situations the leather is folded and subjected to severe treatment, strain and exposure to the weather which ordinarily would cause cracking or flaking of the coating.

Leather made according to this process does not have the objections usually incident to goods made by old and well-known processes. It may be more cheaply manufactured and made with greater expedition than ordinary coated leathers. The successive coatings do not have to be baked and may be quickly dried without artificial heat. Furthermore, cheapness is secured by using cheaper grades of leather to form the basis of the coated product. Leather made according to this process from the split, deep split, or deep buff is every way as good as, if

not better than, goods made from the hand-buff or machine-buff according to the old and well-known processes. Furthermore, it has the greater advantage of not drying out or getting stiff by age and will not be affected by cold weather. This process is patented by Leon Feval.

ALUM TAWING.

This method has for its object the facilitating of the process of tanning by reducing the time consumed, and to leave a salt in the skins that will form a basic mordant for the coloring matter, and at the same time, when the skins are finished, leave them be soft, flexible and waterproof.

The skins are treated in the usual manner to remove the hair or wool, limed, bated and washed, and thus made soft and flexible. A solution is then made of from twelve to fifteen gallons of water, to which have been added nine pounds of alum, two pounds of salt, and thirty pounds of wheat-flour, the whole being thoroughly agitated while subjected to a heat of about 82.4° to 86° Fahr. for fifteen minutes. To the solution are added about twelve pounds of the yolks of eggs, and the solution is agitated for another five minutes.

The mixture is then placed in a suitable drum capable of holding about one hundred pounds of stock, and the whole allowed to revolve for from thirty to sixty minutes, or until the skins have absorbed the contents of the drum. This completes the first step in the process, and is what is commonly known as "tawing." The skins are next removed from the drum and hung up and dried out. Next a solution of sal soda is made, composed of one pound of soda to a gallon of water. In a sal soda solution made up in these proportions, and in quantity sufficient to treat the lot of stock, the skins are placed until they are thoroughly soft and flexible and have assumed a neutral condition. They are then washed in lukewarm water to remove all foreign matter and traces of soda, and are then placed in a bath made by adding sulphuric acid to water until the mixture assumes a density of one to two degrees Baumé. To this solution is added as much of hydrated sesquioxide of chromium or chromic hydrate as will dissolve, and no harm is done when there is a surplus of chromic hydrate remaining in the vessel. Should the solution not be neutral it may be made so by the addition of sal soda until this result has been accomplished. The skins having been neutralized as above mentioned, and afterwards washed, are placed in the chromium solution and the whole agitated for from five to fifteen hours. They are then removed, washed, colored, and finished in the usual way.

The mordant in the skins when combined with the subsequent coloring matter permeates the fiber and greatly adds to the lasting quality of the color and durability of the leather. This process has been patented by Messrs. A. Warter and H. C. Koegel, of Newark, N. J., who claim as new a tawed or alum-tanned skin subsequently impregnated with the sesquioxide of chromium.

TANNING WITH AZEDARACH, GAMBIER, TANNIC ACID, ALUM AND OIL OF CEDAR.

A tanning process in which these ingredients are employed has been patented. The tanning compound is composed as follows: Tannic acid, one pound; azedarach, or the bark of the tree known as the "Pride of China," one pound; gum gambier, one pound; alum, one-half pound; oil of cedar, two ounces.

The hides are first soaked in water until soft and then placed in a bath consisting of one gallon containing approximately three pounds of lime and two and one-half ounces of bicarbonate of sodium. They are allowed to remain in this bath from three to fifteen hours, or until the hair becomes loose, after which they are submitted to the usual process and prepared for tanning.

The tanning compound is then placed in a suitable vat and the skins immersed therein and allowed to soak until thoroughly tanned. The quantities of tanning materials are for two gallons of water. Patented by James B. Tompkins, of Vanderwoort, Ark.

TANNING WITH SUMAC, ALUM AND SALT.

This is a process for the tanning of upper and garment leather, which when exposed to wet weather and dried again will not lose its pliability or strength.

The hides are deprived of hair in the usual manner and are then bated and bran drenched. Tanning is begun by immersing them for four days in a solution of sumac, about two pounds of sumac dissolved in three gallons of water being used for each hide. In preparing the solution the sumac is first boiled in a convenient quantity of water, and then more water is added to approximate the proportions above indicated.

While under treatment in the solution the hides are turned over twice in every twenty-four hours. When removed from the sumac solution they are immersed for three days in a solution of alum and salt, about six pounds of alum and four pounds of salt being used for each hide, the alum and salt being dissolved in sufficient water to cover the hides when placed in the solution. They are turned over twice in every twenty-four hours.

They are then taken out of the bath, and while still damp are treated by wiping over the surface with neatsfoot oil, by means of a cloth, a half of a pint to each hide. They are then thoroughly dried and afterward dampened, staked, shaved, set out and given a medium stuffing with dubbing, consisting of tallow and fish oil mixed together to such a consistency that the mixture can be conveniently worked upon the hides. This dubbing being applied while the hides are damp, the result is that during the process of drying the oil penetrates into them and has the effect of rendering them extremely pliable and durable. They are then hung up and dried, and afterward sleeked off by scraping the dubbing from the surface with a sleeker, cleaned and grained and are then ready to be used.

Leather which has been tanned with alum and salt becomes very hard after getting wet, but by the employment of sumac in the preliminary stages, tanning in the manner indicated, and by applying neatsfoot oil to the hides while they are still damp, the oil penetrates during the process of drying and the leather remains strong and pliable. This process is patented by William MacMillan, of Palmerston North, New Zealand.

NITRATE OF SODA IN SOLE LEATHER TANNING.

It is well known that tannic acid is a strong astringent and that when hides are immersed in a solution containing too great a proportion of it the pores at their surfaces will become closed to such an extent as to retard or even prevent the tanning liquor from gaining access to the interior parts. In the processes now in common use it is necessary to employ at first a weak tanning liquor and to permit the hides to remain in the vats for a long time, for example, for a period ranging from two to four months, depending upon their thickness and other conditions. By immersing them in a liquor containing nitrate of soda in addition to vegetable tanning agents the difficulty mentioned is overcome, the effect of the nitrate of soda being to open the pores and thereby permit the tanning-liquor to readily penetrate into the innermost parts.

In tanning heavy hides, they are first immersed in a rocker in a solution containing two and one-half pounds of tannic acid or its equivalent of vegetable tanning agent and three and one-half pounds of nitrate of soda for every one hundred pounds of water. The hides are allowed to remain in the rocker two days. Then they are removed and placed in the handlers, in a solution which contains five pounds of tannic acid and seven pounds of nitrate of soda for one hundred pounds of water. They are kept in the handlers for four days and are then placed in a lay-away vat, where the strength of the tanning solution is increased to seven and one-half pounds of tannic acid per one hundred pounds of water, and the nitrate of soda is increased to ten pounds per one hundred pounds of water. They are permitted to remain in this solution for about twelve days, when they are transferred to another vat, where the solution contains ten and one-half pounds of tannic acid and fifteen pounds of nitrate of soda per one hundred pounds of water. They should remain in this last vat for about twenty-four days, when they will be completely tanned. As the strength or specific gravity of the solution decreases by reason of the solid matter entering the hide, the deficiency should be supplied by adding tannic acid and nitrate of soda in approximately equal proportions. A greater number of lay-aways or soakings may be employed, if desired, with the time of immersion in each lay-away commensurately decreased. This process has been patented by John Campbell, of Chicago.

NEW METHOD FOR BELT AND SHOE LEATHER LACES.

The description that follows relates to a method of making leather, especially adapted for belt and shoe leather laces, by the chrome process. This is a patented process, the patentee being one James C. McConnell.

The hides are treated in the preparatory process of liming, unhairing and bating the same as any hides for a chrome process. The first step in the making of the leather consists of drumming the hides in a drum, or paddling them in a vat in a solution of alum and salt. This is made up of two pounds of alum and four pounds of salt for each one hundred pounds of hides. In this liquor the hides are treated until they have absorbed the same. They carry sufficient water as they come from the washing process to absorb the alum and salt. After this treatment they are allowed to press, drain and partly dry, when they are split and shaved. The tanning is then completed by drumming, or paddling them in a vat, in a chrome or mineral tannage of any kind, after which they are washed and again partly dried to get them in proper condition for fat-liquoring or stuffing.

The stuffing mixture is prepared as follows: Four ounces of common potash, or other alkali, are boiled in one-half gallon of water until dissolved. Then two pounds of any good degreas and four pounds of tallow are added, and the whole brought to a quick boil. The compound requires to be thoroughly cooked. Then one-quarter gallon of neatsfoot oil is added, and the compound stirred until the temperature reaches a little below boiling-point. Then the compound while hot is applied to the leather, the quantity named being used for one hundred pounds of it, at a temperature of 150 degrees Fahr.

After the leather is stuffed it is set out and oiled off on the grain side with a light coat of neatsfoot oil, then stretched in frames until thoroughly dry. After this it is moistened and staked and softened, and the staking, working and drying are continued until it is soft and dry. Then it is coated on both sides with a light coat of paste made with tallow, starch-flour, soap and water boiled together. It is then dried out again and finished in the usual way. As is the case when alum and salt are used before the chrome process is applied, the object of using them is to pickle the hides so that they will not draw or pucker when put into the tan liquor, and to preserve them so that they can be kept some time before they are chrome-tanned. By first tawing them in alum and salt, and splitting them before they are chrome-tanned, a saving of chrome materials is effected. An interesting feature of this process is in the fact that the salt and alum treatment permits the leather to be stuffed at a high temperature, thus insuring a more thorough penetration of the stuffing greases than is usually the case, and the leather is made very elastic and durable, and peculiarly suitable for lace leather.

Lace leather, made by a chrome process in this way, does not harden,

but remains strong, soft and pliable until it is worn out. The stuffing is done in a worm drum, and all the ingredients must be completely incorporated with each other and thoroughly taken up by the leather before it is dried out.

TOUGH AND WATERPROOF LEATHER.

Hides worked through the process here described form a material which is soft, flexible, durable and waterproof, and which can be applied to various uses, such as the covers of pneumatic tires of the wheels of bicycles or other vehicles, driving belts, soles for boots and shoes, and, in short, for almost any purposes where the material is subjected to a great deal of wear and tear and is required to have great toughness and durability.

The hides are first soaked for a considerable time in water to which a small quantity of sulphate of iron has been added; they are then for a considerable time soaked in a bath of glycerine and a solution of acetate of ammonia, when they are partially dried and treated with a compound of castor oil and alcohol, well rubbed in; they are then piled up until they are thoroughly impregnated with this compound. The final step consists of working into the surface any suitable waterproofing compound.

Hides of any suitable kind are taken and the hair and flesh are removed from them; they are then for a considerable time soaked in cold water. The duration of soaking depends upon the nature of the hide, whether it is thick or thin, and also somewhat upon the preliminary treatment to which it has been subjected. Ordinarily this soaking in water occupies several days. After the water has thoroughly penetrated and softened the hide a solution of sulphate of iron is stirred into the water and the soaking continued. This preliminary soaking, first with water and then with water containing sulphate of iron, occupies several days. Seven days' soaking is usually sufficient, four in water, and three in water and sulphate of iron. If the hides have already been bated, three days' soaking in water containing sulphate of iron is usually sufficient. The quantity of sulphate of iron used varies with the kind of hides treated, with their thickness and with the length of time to which they are submitted to the process. Ordinarily one ounce of sulphate of iron to two gallons of water is sufficient. This is called bath No. 1.

The hides are removed from this solution, allowed to drain, and are then placed in a bath composed of about equal parts of glycerine and a dilute solution consisting of one part, by weight, of acetate of alumina and from four to eight parts of water. This is called bath No. 2. The strength of No. 2 is determined by the character and thickness of the hides and the degree of softness desired in the articles to be made from them when prepared. They are allowed to remain in bath No. 2 from two to six days; they are then removed and allowed to partially dry.

The surfaces of the hides are then treated with castor oil mixed with enough commercial alcohol to make a complete combination between the two. One part of castor oil to five parts of alcohol is usually sufficient. This compound is thoroughly rubbed into the hides, which are then placed in a pile, one above the other, and allowed to remain until the compound of oil and alcohol has thoroughly impregnated them.

The following example is given for the treatment of an ox hide one-tenth of an inch thick : The unbated hide is first soaked in water for seven days, the water containing fifty grains of sulphate of iron to the gallon, the sulphate of iron being, however, not added until about the end of the fourth day.

The hide is then soaked in bath No. 2 for five days, this bath consisting of two gallons of glycerine, one gallon of a saturated solution of acetate of alumina and two gallons of water.

The hide is then allowed to dry, and its surface is treated with a compound of castor oil and alcohol, consisting of three-fourths of a gallon of the oil and four gallons of alcohol. This solution is then rubbed in by hand upon the hide, which is rolled upon itself and placed in a pile of similarly treated goods. The castor oil prevents the glycerine from absorbing moisture and facilitates the absorption of other oils, while the alcohol facilitates the action of the oil or waterproofing compound in penetrating the hides which have been treated with glycerine and acetate of alumina.

If the finished hides are to be used in such a way that they will be exposed to great moisture, any of the well-known waterproofing compositions may be used ; for example, tanner's oil, which is a mixture of neatsfoot oil and tallow, or tar oil, which is the ordinary product of resinous or tar distillation, or other vegetable or mineral oil, or wax, or shellac or similar substances, either alone or mixed with a solution of India rubber, is worked, either hot or cold, into the surface of the hides. The goods thus treated form a soft, durable and waterproof material. The process above described has been patented by Horatio W. Southworth, of London, Eng.

{ TREATMENT FOR PICKLED SKINS.

This process is useful, it is claimed, in neutralizing acid-pickled skins and preparing them for tanning. The skins are immersed in a light alkali solution, a nitrate of an alkali or an alkali earth. The method is as follows : Prepare, for example, a solution consisting of ten ounces of nitrate of soda in seventy gallons of water, so as to be slightly alkaline or neutral. This solution will neutralize and oxidize one dozen of Australian pickled sheepskins. By pickled skins are meant such as have been subjected to the action of a pickling solution but have not yet received any tannage.

For this purpose various pickling processes are employed, such as sulphuric, lactic or acetic acids in conjunction with common salt, but

the ordinary pickle consists of sulphuric acid and common salt. This method is effective on all pickled skins no matter how they are pickled.

Naturally the quantity of the solution must be regulated according to the number of skins to be tanned. For skins tanned with a mineral tannage, such as sulphuric or hydrochloric acid, in case of the two-bath chrome process and which contain sulphuric, hyposulphurous and thio-sulphuric acids, a solution of five ounces of nitrate of soda in seventy gallons of water may be used. This solution is also slightly alkaline or neutral and will neutralize or oxidize one dozen of tanned skins.

On all these acids the action of the nitrate of sodium is similar at an ordinary temperature ; it also exercises an oxidizing effect on all the free sulphur present. The quantity of solution to be employed is regulated by the number of tanned skins to be treated.

By the above described method a larger surface of leather is gained than if the solution is not employed, a superior product is assured, the skins will also have a smooth surface and are much more porous and soft.

Pickled skins treated with this solution may be tanned more rapidly on account of their greater facility for absorbing the tanning liquor.

Naturally an excess of nitrate of soda is not harmful because it remains in the solution ; and smaller proportions of it than those specified may be employed, but it is preferable to use the solution of the strength above mentioned. In all cases it must be neutral or slightly alkaline. Patented by Otto P. Amend.

LACTIC ACID IN PLUMPING AND TANNING LEATHER.

In the ordinary tanning processes as now practised, a number of vats are usually provided and are filled with tanning liquor of different degrees of strength, the hides being placed in the vat containing the weakest liquor and thence removed to the next succeeding vat in which the liquor is stronger. Some tanners prefer to let them remain in a single vat and to change the liquor around them. When this is done, the liquor first brought into contact with them is comparatively weak, and stronger liquors are used as the tanning process progresses. In the ordinary methods of tanning the natural tan bark, for instance, the bark of the chestnut oak or the bark of quebracho wood, is sometimes leached or steeped in water for the purpose of making the tanning solution. At other times the tanning liquor is made of a solution of some one of the commercial tanning extracts dissolved in water. Sometimes the tanning liquor also consists of a double solution containing both the leached extract of natural bark and commercial tanning extract prepared artificially. This invention relates more particularly to tanning processes in which either a commercial tanning extract is exclusively employed or in which it is used in conjunction with the extract made by leaching the natural bark.

A twenty-five per cent. solution of commercial lactic acid is taken

and apportioned to the quantity of hides to be tanned at the ratio of one-half to three-quarters of a pound of the acid for every one hundred pounds of hides. This proportion is preserved no matter what may be the purpose for which the stock is tanned or what may be the stage of the tanning process. After putting this commercial lactic acid into the solution, the tanning process goes on as stated, with this difference, to wit, the lactic acid plumps the hides, that is, causes them to distend and swell and thereby tan more quickly.

As the commercial tanning extracts are of vegetable origin and as the natural tanning extract obtained from the natural bark produce a tanning solution also of the same origin, this process is more peculiarly applicable to so-called "vegetable" tanning.

The addition of lactic acid to the tanning liquor of the kind described, whether it be formed from the natural bark or from some commercial tanning extract, causes the hides to retain their substance and to combine with a larger proportion of the tannin, thereby making a superior quality of leather of proportionately heavy weight. This gives the process great commercial value, for the reason that it converts a comparatively cheap substance into a high-priced commodity. In other words, the greater the amount of tannin which can be made to combine with the albumen of the hide the better will be the leather and the greater will be the weight thereof. As this kind of leather is sold by weight, the advantage can readily be seen.

The fluid known among tanners as "sour liquor" has been used with more or less success in the plumping of hides and possibly has been applied successfully to them in various stages of the tanning process. This sour liquor possibly contains traces of lactic acid or some acid having more or less similarity thereto. It is, however, formed during a fermenting process from the natural bark and is therefore peculiar to the use of it. When commercial tanning extracts are employed, there is little or no fermentation, and therefore the organic acids formed are not sufficient in quantity to properly plump the hides. It therefore becomes necessary to add some plumping agent; and for this purpose commercial lactic acid has been found to be the most suitable.

When the hides are tanned by the use of a double solution containing both the extract of the natural bark and a commercial tanning extract, the sour liquor produced from the natural bark is of such small quantity as to be inadequate for the purpose of properly plumping the hides. Lactic acid can be used to advantage in this tanning process as well as in that in which a commercial tanning extract alone is employed.

By the method that has been described a tanning liquor of the very highest order can be successfully prepared without the direct use of any natural product whatever—that is to say, all of the substances used in the entire tanning and plumping processes can be bought in the market as articles of commerce. There are some tanners, however, who, be-

cause of the abundance and cheapness of the natural bark in a particular locality, or who, for other reasons, desire to use the natural bark, to some extent at least, find, as before stated, that there is not enough sour liquor formed for properly plumping the hides. In the latter case commercial lactic acid and a commercial tanning extract can be used along with such proportion of extract made from the natural bark as may be deemed proper. It makes no difference what may be the relative proportions of the natural bark and the commercial tanning extract, the lactic acid working equally well in all cases. It has been found, too, that lactic acid can be used to equal advantage whether the process be one of original tanning or of retanning. A mixture of the extract of natural bark and of a commercial vegetable-tanning extract is usually employed in retanning. This process was patented in 1902 by Sigmond Saxe.

Lactic acid has become an important factor in the manufacture of leather. It is largely used in tanning processes to make the leather plump and well filled and therefore heavier; and it is also employed for the purpose of removing lime from hides and skins before they are tanned. Hides immersed in a cold solution of lactic acid in water plump considerably and accept the tanning liquors more rapidly and thereby acquire a better color and more weight. When lactic acid is used in the yard, the leather is made heavier, with a finer and more mellow grain and an improved color. Used in retanning splits, it makes them heavier than they would otherwise be. Bating hides for sole leather with lactic acid rids them of lime without the loss of any of the substance which is so important that it should be retained.

THE MANUFACTURE OF INTESTINAL LEATHER.

This process has for its object the production of a leather from the intestinal membrane or coat, that on being bleached has the appearance of ordinary glove-leather, or kid. It is, however, essentially distinguished from such leather by the absence of pores, thus rendering it impervious to moisture and gases and by its extreme thinness, coupled with great toughness or strength of fiber. It is distinguished from gold-beater's skin by that it may be sewed, the seam being firm and the leather closing tightly around the thread, and also by its extreme pliability and softness.

The properties above stated render this leather peculiarly suitable for the manufacture of gloves for those whose occupations render it necessary to effectively protect the hands against infectious matter and poisonous solutions or baths, the extreme pliability and softness permitting a free movement of the fingers and its thinness giving the sense of touch full play. Unlike the goldbeater's skin, it may be boiled without injury, so that a surgeon's glove made from it may be dipped into a formaldehyde solution and then boiled for the purpose of cleaning, disinfecting and sterilizing it. This is a matter of great importance.

This leather is applicable to a great variety of purposes in the useful and fine arts. Thus, for example, it is exceedingly well adapted for ink ribbons. As a covering for balloons for signaling, military and other purposes it has been found superior to the ordinary silk covering by virtue of its greater lightness, less bulk, pliability, softness and imperviousness. It can be dyed various colors. When dyed it may be used in place of ornamental papers. As a starting material, serves the outer peritoneal coating of the caecum of blind gut of the ox, the same substance which is used as goldbeater's skin in the making of goldfoil. In most of the slaughtering establishments in the United States and in Germany this membrane is now removed from the intestine which it envelops and supplied in this condition to the manufacturers of goldbeater's skins or to goldbeaters.

In order to convert this delicate membrane into leather first remove all fatty substances and adhering impurities therefrom by the following treatment: The membranes are first rinsed in warm water, preferably in three graded baths, each having a higher temperature than the preceding one. Best results are obtained by making the temperature of the first bath 25° Centigrade, that of the second 30° C., and that of the third 35° C. (77, 86 and 95 degrees Fahr.). The membranes are next immersed and left for about five minutes in a bath composed, for one hundred membranes, of ten grams permanganate of potash dissolved in three liters of water and having a temperature of about 80 degrees Fahr. They are then placed into a bath of twenty grams of sulphurous acid dissolved in three liters of water and having a temperature of about 80 degrees Fahr. In this bath the membranes or skins must be left until they have swelled up and attained a pure white color, whereupon they are taken out and again submitted to three rinsings in warm water of 77, 86 and 95 degrees Fahr. successively, as above. They are now ready to be immersed in a soap solution or bath which is preferably prepared by boiling about one-half kilogram (1.1 lbs.) of good, pure, white toilet soap, such as white castile soap, in one and one-half liters of water for one hundred membranes, the temperature of the soap bath having been first reduced to 95 degrees Fahr. by the addition of one-half liter of cold water. In this soap bath the membranes remain for several hours, until the soap has been completely absorbed, whereupon they are put successively into two baths of warm water having a temperature of about 80 degrees Fahr. for the purpose of completely washing or rinsing them.

They are now ready for the tanning or tawing process, which is as follows: A solution is prepared by dissolving, for each one hundred membranes, one hundred grams chromic acid and fifty grams of alum in one liter of water of 95 degrees Fahr. The membranes are placed in a bath of warm water, preferably one liter of water of 80 degrees Fahr. The chromic acid solution is gradually added to the membranes in the warm water bath while agitating or stirring them. Preferably the following course is pursued: First, about one-eighth of the chromic

acid solution is added to the membranes, then after about ten minutes a further one-eighth of the same, and after a further ten minutes one-fourth of the original amount of the chromic solution, and finally after twenty minutes the rest of the chromic solution is poured into the bath containing the membranes. In this final bath the membranes are allowed to remain for one hour while being constantly agitated or stirred. They are then removed from the tawing bath and rinsed twice with warm water of 80 degrees Fahr. This completes the tanning or tawing process.

The inventor finds it advantageous to immerse the tanned membranes in a bath composed of five hundred grams of yolks of eggs and one hundred grams of glycerine added to two liters of water and thoroughly mixed with it. In this bath the membranes remain about ten hours. They are then removed and drained by hanging over or from lines or ropes, whereupon they are placed on suitable frames or supports and allowed to dry. After they have thus lain for about eight days they are stored in moderately damp chambers or inclosures and are then drawn over crescent-shaped blunt knives over their entire surface until smooth and pliable, or any other smoothing manipulation may be employed for this purpose.

The leather is now finished and may be used in this condition, but for many purposes it may be found desirable to further finish or embellish it. It may be dyed beautiful colors, and for this purpose it may be immersed in a bath containing the desired dye, such as aniline dye, in quantities governed by the color to be imparted. A bath containing from three to five per cent. dye will usually answer. To this bath a mordant consisting of four cubic centimeters of acetic acid of fifty per cent. strength is added. In a bath so prepared the leather remains several hours. Further, it is claimed that by this process the leather, whether dyed or undyed, may be still further finished by passing it through calendering-rolls. In some cases colored talcum powder may be sprinkled or dusted over it, and be then calendered. It is also desirable in some cases to coat the undyed leather with a thin film of a composition prepared by mixing eight parts collodion, one part castor oil and one part caoutchouc solution. Leather so coated is adaptable for gloves, accordion-bellows, balls and the like.

When it is desired to obtain a thicker and stronger leather which, however, is not so well adapted to be dyed, a tanning bath consisting of one hundred grams of sulphate of zinc, forty grams of alum and fifty grams of wheat flour properly mixed with one liter of water may be used to tan one hundred membranes, the other conditions and steps of the process remaining the same as above. This tanning bath is used instead of the chromic tanning bath above described. This treatment yields pure white, lusterless leather of greater body than that produced by the chromic acid method. This process is patented by Bruno Trenckmann, of Berlin, Germany.

MANUFACTURE OF PARCHMENT-LIKE SKIN.

In the process as usually carried out, the peritoneal membrane of the gut, after having been cleaned of fat and soaked in a bath of soap, is immersed in a bath of sulphate of zinc, chloride of barium or any similar mineral salts which are able to produce pigments, insoluble in water, by double transposition with any inorganic salts, acids or bases.

This process consists in alternately treating the skins in such baths at certain definite temperatures. For example, the gut membranes are first rinsed from five to ten minutes in a solution of sulphate of zinc or other mineral salts, of about 15 degrees Baumé and at a temperature of 4 degrees C. (39.2° Fahr.). They are then put in a solution preferably of carbonate of sodium of about 15 degrees Baumé and at the same temperature, and treated therein for about the same period of time, raising the temperature, however, to 15 degrees C. (59° Fahr.). They are then returned into another solution of sulphate of zinc at a temperature of 0 degrees C. (32° Fahr.), and then into a solution of carbonate of soda at the same temperature. They are then finally returned to the solution of sulphate of zinc at a temperature of 6 degrees C. (42.8° F.), and then into a solution of carbonate of soda at the same temperature. This treatment is repeated until the skins have absorbed a sufficient amount of the pigment, which is attained usually after two or three treatments.

By this process a parchment-like, clear, white or well-colored product is obtained, which may come in contact with water and when again dry will appear as before. Further, this product, unlike leather, is capable of being extended when soaked, and will again shrink while drying, thus making a tight cap, perfectly air tight, so desirable for closing bottles of all kinds. This process is the invention of Bruno Trenchmann, of Berlin, Germany, who has taken out a patent on it.

TANNING WITH PERSIMMON BARK, BROOMWEED, GAMBIE AND ALUM.

In this process of tanning persimmon bark is used in a tanning compound with other well-known ingredients that have high tanning properties. The tanning liquor consists of broomweed, gum gambier, alum, common salt and persimmon bark in about the following proportions: Broomweed ooze, ten gallons; gum gambier, four pounds; pulverized alum, one pound; common salt, two pounds; persimmon bark, three pounds.

To make ten gallons of broomweed ooze, take fifteen gallons of water, and to this add thirty pounds of broomweed. This mixture is boiled from one to two hours until one-third of the water has been evaporated, leaving ten gallons of ooze ready for use. The gum gambier is dissolved in as small an amount of water as possible and when dissolved is poured into the broomweed liquor. The alum and salt are both poured into the mixture while still warm, and the latter is then stirred until the alum and salt are dissolved. The freshly-peeled per-

simmon bark is added at the same time the hides are put into the liquor and will have imparted its strength to the mixture within twelve hours.

The hides or skins are soaked, limed, unhaired and bated or drenched in any suitable manner and are then placed in the above-described liquor and remain in it until they are thoroughly tanned, which requires from about six hours for thin hides to ten days for heavy ones, in warm weather, but in cool weather it will take about a quarter longer time for proper tanning.

To give the desired color to the hides, any well-known coloring agent may be employed. When properly tanned they may be treated in any manner that will give the leather the finish that is wanted. This process is patented by James L. Martin, of Terrell, Texas.

LEATHER FOR HORSE COLLARS, HARNESS PADS, ETC.

This process of tanning consists of the use of an antiseptic tanning composition for leather intended to be used as a lining for horse collars, all kinds of harness pads, and similar appliances. To make such hides more appropriate for this particular purpose, the hair is not removed from them, because resting next to the skin of the animal they form a soft bolster, are cool because this hairy layer permits free evaporation and escape of the perspiration, keep as a consequence the harness dry, and protect it against mold and rot, and finally, by their softness prevent the growth of sores on the animal.

To tan and prepare hides for such linings, so as to keep them from rotting from constant contact with the moist perspiration ; to make them soft and tough ; to preserve the roots of the hair in a manner to prevent it from falling out ; to render them harmless and salubrious by proper medical and antiseptic treatment, and to keep moths and other insects out, has been fraught with many difficulties.

In the first place all fatty substances which might tend to cause fermentation and rot must be eradicated ; secondly, to make and keep the leather pliable and to prevent the perspiration of the animal from entering and saturating it, setting up fermentation and causing rot, its pores must be filled with an unctuous and preserving substance ; thirdly, the pores should be contracted to toughen the leather, and also to guard against all possibilities of any of the hair falling out, and lastly, the odor caused and remaining from the tanning process should be eliminated. The means selected to comply with all these conditions must be of such a character as to be not only harmless to the skin of the animal, but in addition should have such medical and antiseptic qualities as to prevent sores, to heal them and prevent their spread in cases where they exist, and finally they should harden the skin in places where the pads are in constant contact and bear on it.

To fulfill the first condition, corrosive sublimate is the most suitable means. It acts as an antiseptic and germicide by killing or neutral-

izing all such matter which might cause decomposition. For the second requirement phenol (carbolic acid) or the preparations derived therefrom are used. It or they fill the pores of the hide, and by unctuous properties keep the same soft and pliable. The third condition is best complied with by the application of salicylic acid, which contracts the pores of the hide and toughens it. The fourth condition is satisfied by menthol, which by its penetrating odor eliminates the scent of the tanning process adhering to the leather.

In cases where pads lined with leather so prepared come in contact with sores on the animal, the corrosive sublimate, in combination with the phenol contained in the pores of the lining, will stop the spread of the sores, and by virtue of the antiseptical and germicidal properties of these drugs will heal them and prevent their recurrence. In addition to the named effects on the skin of the animal, these drugs in combination with the salicylic acid will also harden it. Hides so saturated are fully germ and moth-proof, because the drugs used in their treatment are inimical to insect life.

The chemicals named may be applied by adding them to the ordinary tanning liquor prepared from sumac or bark in which the hides are immersed, and in which case the procedure is the same as the usual tanning process, or they may be applied as a dressing by means of a brush after the ordinary tanning process has been gone through with. The temperature of the composition is preferably from 60° to 70° Fahr. The menthol in a solution of five parts in ninety-five parts of alcohol is best applied separately and lastly in the form of a spray. As regards the proportion of said chemicals, one part of corrosive sublimate, eight parts of phenol, and one part of salicylic acid, all dissolved in sixty parts of water, produce the best results. The quantity of water may be varied, however, in order to produce a more or less concentrated solution, by the strength of which the duration of the tanning process may be lengthened or shortened. Equivalents may of course be substituted where they produce the same results. For instance, boracic acid may be used in place of the corrosive sublimate, and also instead of the salicylic acid. For the phenol any of its species may be used.

Hides or leather so prepared preserve remarkably well, and are rendered exceedingly tough and tenacious without losing their pliability and softness.

The preparation, if mixed with the ordinary tanning liquor will hasten the whole tanning process and keep the liquor from spoiling or getting sour. Patented by Julius Engelke, Cincinnati, O.

PROCESS FOR LACE, BELT AND GLOVE LEATHER.

The object of this process is to accelerate the operation and to reduce the cost of manufacture, and at the same time produce a leather the quality of which is superior to any tanned leather on the market. The usual results of any attempts to hasten the process of tanning are that

the quality of the leather is injured more or less. The hides to be treated by this process are handled as follows: They are soaked in clean, fresh water over night. Next they are fleshed and washed in the wash-wheel in order to remove from them the salt and dirt, and are then again put into clean water and left therein over night. They are then tied together head to butt, though when intended for belting, the heads and bellies may be cut off and prepared for sole leather, and they are then put into a lime vat, and by means of chains and reels handled from one lime vat to another for about eight hours. They are then transferred to warm-water vats and treated for six or eight hours with water at about 80 degrees Fahr., and are passed from one vat to another.

They are then allowed to remain in warm water of about 80 degrees Fahr. for a time, say over night, after which the hair can be readily removed. After the unhairing, which may be done in the usual manner, they are washed in clean water and freed from lime by the working incident to unhairing or short-hairing. Being thus freed of lime by working on the grain side and short-hairing, they are worked on the flesh side, fleshed or shaved. When cleaned and shaved they are put into clean, cold water for a time, say over night, to swell them, although this is not absolutely necessary, and then into a coloring wheel, together with a liquor of about twenty per cent. cutch or catechu. Enough of this liquor is required to cover them and to produce an even color. To this liquor are next added about thirty pounds of common salt for every thirty hides under treatment, and the wheel kept in operation for about four hours to insure the hides being evenly colored. To the liquor are then mixed three pounds of alum, one pound of salt, one twenty-fourth pound of borax and one-half pound of flour (preferably rye flour) to each hide under treatment, and enough of this liquor is used to keep the hides covered, and they are left in this liquor from two to four days, being handled with the wheel for two to three hours each day. The strength of the liquor is then renewed, two or three times, according to the weight of the stock, and the hides handled therein until they are sufficiently tanned. They are then hung up in a drying loft and when thoroughly dry are dampened in a vat of catechu, at about 60 degrees Fahr., containing from twenty to thirty per cent. of catechu. They may now be put into a stuffing wheel for about one hour, then taken out and oiled with neatsfoot oil on the grain side, and next put back into the stuffing wheel for about an hour.

They are now in suitable condition for glove leather and similar uses, or they may be stuffed with a stuffing made from tallow and wood tar, composed of one hundred pounds of tallow and twenty pounds of wood tar boiled and skimmed until they unite, and kept working in the wheel until dry. They may then be worked in any suitable manner until they are well stretched out. The leather treated in this way may be finished for either belting or lacing. It may be cut up, dampened and shaved, stuffed again with tallow and tar, and also neatsfoot oil, when desired, in a stuffing-wheel while still damp for about an hour, and then dried

for lace leather ; or it may be dampened, if too dry, in liquor, same as before, stuffed again and set out on a table and cut up and stretched for belting ; or it may be treated to make harness leather, being blackened before oiling and otherwise treated the same as for lace leather. Other kinds of leather may be finished in the usual way. Instead of stuffing the hides, they may, after being dampened with catechu to fill them with tannin, be treated with a tanning liquor to set the catechu, as in the ordinary process of tanning to make sole and similar leathers. When finished in this way, it is preferable to use a somewhat stronger liquor for filling, say one containing sixty per cent. of catechu. Of course modifications may be made in the use of this process according to the kind of hides being treated and the kind of leather desired.

PROCESS FOR LACE LEATHER.

This process of tanning has for its object the treating of hides and skins in such manner as will prevent them from becoming hard, and thus to produce leather having the qualities of softness, pliability and strength to an unusual degree. In applying the process, the hides or skins, after having been cleaned of all impurities, such as blood, salt and lime, are spread out smooth, and a coating of powdered crystal Glauber's salt is applied to them. For a ten-pound skin as brought from a slaughter-house in its green and wet condition, one and one-half pounds of the salt will be found sufficient ; while at least six pounds should be used for a hide weighing from forty to sixty pounds. About one-half of the salt is spread over the hide in the first instance, after which it is permitted to lie for about twelve hours, in order to have the salt absorb all the moisture, and when this time has expired the balance of the Glauber's salt is applied. The goods are then again exposed for from twelve to twenty-four hours. The next step is to smooth the hide out upon a table and to treat it to a composition composed of one-fourth aqua ammonia to three-fourths of oil or grease, preferably unadulterated cod-fish oil. This mixture is coated upon both sides of the hide by means of a brush. In the case of oils and grease of poor quality, the quantity of aqua ammonia should be less than above, while in the case of richer oil and grease, it should be increased. The hide is now exposed for drying purposes. After drying, it is placed in clean water to dissolve any sulphate of ammonia or any of the parts of the Glauber's salt that may remain. It is then ready for the work of setting or stuffing, and after drying out again there is no staking necessary, as the leather will remain soft. The insoluble fatty compound will remain in the hide and adhere to the fibers severally, and not in a mass, leaving them independent of each other, thus securing a perfect tanning, and putting the hide or skin in condition to reject water to a great extent.

Instead of pulverizing the crystals of Glauber's salt and applying the same in dry powdered condition, the skins or hides may be placed into

a solution of common salt and sulphuric acid, commonly called the "pickle." After they have passed through this pickling process, the mixture of aqua ammonia and cod-fish oil is applied in the manner that has been described.

SOFT, WATERPROOF LEATHER.

The object of this process is to provide a method of tanning leather whereby the hides are rendered soft and pliable. Their pores are opened to permit of the thorough and effective penetration of the tanning liquor, and by being then closed, the leather or hides are prevented from cracking, all the glue and gelatine therein being retained. The leather is consequently water-proof, and the liquor is prevented from souring, these objects being among the chief advantages of this process.

In applying this process, the first step is to place the hides in a vat containing lye and salt, in the proportion of ten pounds of the latter to one pint of the former for each hide of light weight. After soaking the hides a specified time, as well understood by those familiar with the work, there is from time to time added a small quantity of lye, until the hair of the hides begins to loosen. Should at this stage of the procedure a deodorizer be required, about one hundred drops of carbolic acid may be added. The second step is the liming of the hides, for which purpose, instead of lime as commonly used, lye or ashes is employed, one quart of either of which with water being added daily until the hair has become loosened. With a small amount of lye left in the hides, the latter will not crack, as has been experienced with the use of lime, in passing them through the tanning process proper; also in the bating of them which is the next step, the lye that remains in them will prevent the liquor from becoming sour. Bating is carried out by adding to the liquor bran to the extent of a peck at the beginning. The final or last step consists of subjecting the hides to the tanning process, the liquor of which is made of the following ingredients, in the quantities named for a single hide: Ten pounds of salt, one pound of saccharine matter (sugar), to which are added one pound of French ochre for coloring purposes and one ounce of borax to impart softness to the hide, and water sufficient to cover the latter. The said ingredients together with water, are of course added in the same proportion for each additional hide placed in the vat.

The liquor thus produced may also be used with all astringents, and with it, and with previous treatment of the hides, the latter are possessed of the following qualities, in addition to those already mentioned: The resultant leather can be exposed to the action of water for days, and it will be perfectly impervious thereto, and the tanning is effected in a minimum space of time, while the best color is obtained for the leather. Patented by G. W. Hersey, Empire, Wis.

NICOTIN IN LEATHER TANNING.

This invention has for one of its objects the provision of certain improvements in processes of tanning which will materially reduce the time now required for the conversion of the hide or skin into leather without impairing the quality of the latter; and it has the further object to provide, in the art of converting hides or skins into leather, a step or process that will act to loosen the hair and to shorten the time of tanning.

Hides subjected to the action of solutions containing nicotin become more permeable by, or susceptible to, the action of ordinary tanning agents; so that a hide that has been "nicotinized," as it may be expressed for the sake of convenience, may be tanned in a shorter time than otherwise.

It has been found that among the materials which are suitable for these purposes are commercial tobacco extracts, well known in the trade as insecticides or sheep dips, but as many of such extracts have a stated low percentage of nicotin, a comparatively large quantity would be required to produce the desired result, it is better to use a solution, which has been improved by purifying or removing in any suitable manner non-nicotinous extractive substances even up to the point of producing a pure nicotin. Such very pure nicotine solutions, however, are at present unduly expensive, and a solution up to about ninety per cent. purity, that is, with about ten parts of other extractive matters, to ninety parts nicotin, has proved to be entirely satisfactory. In the practice of this process it has been found that from half a pound to a pound and a half of nicotin suffices to treat one hundred pounds of hides or skins, enough water being used with it to cover them. To produce this bath, any of the commercial nicotins or tobacco extracts may be employed in proportions sufficient to yield the stated amount of real nicotin, as determined by analysis. The above-mentioned quantities may be found to be excessive and may be varied without departing from the spirit of the invention. It has been found that thoroughly satisfactory results may be obtained from the use of a nicotin solution having the following composition as shown by analysis:

Nicotin alkaloid "C-10 H-14 N-2"	90.00
Extractive matter, gum, etc.	3.00
Fat	1.00
Water	6.00
	<hr/>
	100.00

The percentage of water may of course be increased without affecting the purity of the nicotin, for example the same solution may be diluted with water so as to analyze:

Nicotin alkaloid "C-10 H-14 N-2"	45.00
Extractive matter, gum, etc.	1.50
Fat50
Water	53.00
	<hr/>
	100.00

The solution above referred to will put the raw hides or skins in such condition that the tanning process may be completely effected in from two weeks to three months. It has been found that when the raw hides or skins are subject to the nicotinizing treatment prior to the final step of tanning, it results in putting them in such condition that the tan bark or other tanning liquor employed in the ordinary tanning processes is enabled to penetrate them in from one-fourth to one-half of the time now required for such penetration.

It may be stated that immersion for about six hours is sufficient if the hair has been previously removed, but when it is desired to cause the solution containing nicotin, to also effect the depilation of the hide, the immersion should be prolonged to periods varying from twelve hours to three or four days, according to the nature of the hides under treatment.

TREATING LEATHER WITH THE WASTE SULPHITE LIQUORS OF WOOD-PULP MILLS.

This invention relates to a method of treating partially-tanned leather with the waste liquor of pulp mills.

After the hides have been subjected to any active tanning material and have been struck through, or colored from surface to surface by the tanning solution, the now partially-tanned leather is removed to the revolving drum or wheel and is subjected, while undergoing agitation, to the action of an agent consisting of an extract derived from the waste sulphite liquors coming from sulphite wood-pulp factories, and having a specific gravity of from 1.10 to 1.35. This range in the specific gravity has been found to meet all requirements that arise including different kinds of partially-tanned leather. It has been ascertained that if the specific gravity be below the minimum stated, there will not be sufficient weight in the concentrate to make the filling operation pay, and the concentrate will be too thin, while if above the maximum limit prescribed it will be too thick to enter the pores of the partially-tanned leather. The revolution of the drum causes the hides to absorb the extract and thus materially increase their solidity and weight. After a sufficient quantity of the extract has been absorbed, the leather is removed from the drum, and dried and finished in the usual manner.

The constituents of the sulphite extract used, from a tanner's standpoint, are about as follows: Total solids, forty-eight per cent.; insoluble matter, one per cent.; tannin, or matter that will combine with raw hide, from eighteen to twenty-two per cent.; non-tannins, from twenty-five to twenty-nine per cent. The non-tannins in this case consist of the sap and sugars of the wood, which have been treated with the sulphite liquor in the manufacture of the pulp, and will also contain sulphur compounds of these organic matters and the small amounts of lime and free sulphurous acid which have not been removed by the process of clarification to which the liquor has been subjected before being made into extract and before it reaches the tannery.

The advantage in employing purified filling liquor is that it is cheap, being practically a waste product, and its action is rapid and therefore materially reduces the cost of the procedure. This process is patented by William H. Teas, of Ridgway, Pa.

PYROXYLIN IN FINISHING VARNISH FOR PATENT LEATHER.

The following process is a method of finishing patent leather, which, it is claimed, is cheaper, quicker and more convenient of execution than other methods, and the character, gloss and wearing quality of the leather are enhanced.

In manufacturing patent leather, after a sufficient number of preparatory or ground coats have been applied and pumiced when dry to make them smooth there is applied one or more finishing coats of a pure linseed oil varnish for the purpose of giving the high gloss desired. The inventor of this process has heretofore improved upon this common method by using for the preliminary coats a pyroxylin varnish and superimposing thereon as a gloss-giving varnish a finishing coat of drying oil; but in either of these two old processes certain difficulties are encountered in the application of the finishing coat or coats of the gloss-giving or drying-oil varnish. Thus, for instance, the application of the gloss-giving coat of linseed oil varnish frequently produces small pimply specks. Again it is necessary after drying the leather with the finishing coat of linseed oil varnish in heated chambers to expose it for a certain length of time to the action of sunlight before it is sufficiently dry for shipment. This carries with it the necessity of large yards to be used in the sun-drying operation, the expenditure of considerable time, more especially in cloudy weather, and the constant watching of the skins and their removal to shelter in case of rain or storms. In addition to all this the finished article produced by these old processes shows an inclination to crack by reason of the tendency of the linseed oil coating to become brittle, and this cracking often occurs spontaneously by mere changes of temperature without apparent cause.

By means of this improved process the above-mentioned difficulties are removed. It has been discovered, as a result of a long series of experiments, that if the gloss-giving or finishing coats consist of a mixture of linseed or other drying oil and pyroxylin in solution, with or without the addition of substances to increase the flexibility, the coats do not have a tendency to form a pimply surface, but dry smoothly and evenly. Again, the finishing coats can be sufficiently heated in the drying room for immediate shipment without the tedious exposure to the sun, thus insuring the continuity of the manufacture irrespective of climatic conditions. Finally, the finished article has lost much of its tendency to crack spontaneously. The pyroxylin in solution which is added to the finishing coats of drying-oil not only seems to impart tenacity to these coats, but also to retard oxidation, which is constantly going on in the linseed oil coats after they are dry. The proportion

of linseed oil and pyroxylin, which constitute the gloss-giving coats, may be varied within wide limits. Thus where the finished product is to be used for the tips of shoes, which are not subjected to much bending, a less proportion of drying oil may be used than when the leather is to be employed for the body of shoes, which must suffer considerable bending. The proportions of drying-oil and pyroxylin in the mixture may be varied from such as contain more pyroxylin than drying-oil to such as contain more oil than pyroxylin. In fact, somewhat small quantities of pyroxylin are calculated to impart to the mixture the desirable qualities above enumerated. For the material above referred to, intended to impart flexibility to the finishing or gloss-giving coat, any substance ordinarily employed to give flexibility to pyroxylin may be used, for instance, non-drying oils. There is first applied to the leather one or more of the usual preliminary coats such as linseed oil with a pigment, or a mixture of linseed oil and a soft rubber or a coating of pyroxylin. On these preliminary coats is applied one or more gloss-giving coats consisting of a mixture of a drying oil and pyroxylin, which is formed by dissolving the pyroxylin in one of its usual solvents, such as a compound ether or a ketone, and then mixing the pyroxylin solution with the drying oil in the desired proportion. There may be used for the gloss-giving coats a mixture of drying oil and pyroxylin prepared as follows :

Take a solution of pyroxylin in amyl acetate by itself or mixed with benzine or turpentine. Thus six ounces of pyroxylin may be added to one gallon of amyl acetate. To 80 cubic centimeters of this solution may be added 80 cubic centimeters of linseed oil or linseed-oil varnish, that is to say, linseed oil which has been boiled with suitable driers. The preliminary coat or coats having been applied, the gloss-giving coat or coats, consisting of a mixture of a drying oil and pyroxylin in solution, are applied, and when these have been dried in heated chambers, the leather is finished and ready for its intended use. This process is patented by Byron B. Goldsmith, of New York.

PROCESS OF FINISHING UPPER LEATHER.

The leather produced by this process possesses decided advantages as regards cheapness, durability, utility and general appearance, and particular attention is directed to the inner or flesh side of the leather, which is colored a dull blue-black, giving it a distinctive appearance, which is so desirable, and furthermore assisting materially to lessen the cost of its manufacture.

The process used for the finishing of a calf or kangaroo skin or hide into leather adapted for the above uses is as follows : An unstuffed calf or kangaroo skin or hide, tanned by a gambier, quebracho or other vegetable tanning process, is stuffed to its proper constituency by the use of fat-liquor and then dried in the usual manner. The inner or flesh side is colored a blue-black by any desirable composition. After

the flesh or inner side is blue-black, the outer or grain side is colored a jet-black by any desirable composition. After the inner and outer faces of the skin or hide have been colored as desired, the same is then slicked out smooth to set out the grain on its outer or grained face. The skin is then dried in the usual manner. It is then staked and trimmed in the ordinary way.

The skin or hide is then seasoned by the use of blue-stone, iron, logwood, ammonia, blood and nigrosine, the proportions being as follows: Blue-stone, one-half pint; iron, one-eighth ounce; logwood, one-half pint; blood, one pint; nigrosine, one-half pint. The skin or hide after it has been seasoned, is then dried at 120° to 180° Fahr. After it is dried it is glazed in any desirable manner.

After it has passed through the glazing process it is again staked. When it has been staked it is seasoned again by the use of blue-stone, iron, logwood, ammonia, blood and nigrosine in quantities and proportions the same as in the first instance. After the seasoning it is dried at from 120° to 180° Fahr., and is then glazed in any desirable manner.

After the glazing process is finished, it is again staked, seasoned again by the use of blue-stone, one-half pint; iron, one-eighth ounce; logwood, one-half pint; blood, one pint; nigrosine, one-half pint. It is then again dried and glazed, and is now ready for the market.

The leather produced by the foregoing process has an unusually high-polished, grained surface, and possesses all the qualities of the ordinary leathers now on the market. It has to a great extent the appearance of patent or enameled leather, as well as glazed kids and other glazed leathers. At the same time, when in use it will be free from excessive cracking or breaking, which is usual in patent and enameled leathers. A patent has been taken out on the above process by Messrs. C. E. and H. A. Lappe, of Pittsburg, Pa.

PATENTED PROCESS FOR WEIGHTING SOLE LEATHER.

This process is said to increase the durability and wearing capacity of sole leather; also to increase its weight while changing its general character for the better. Ordinary sole leather is soaked in water until it is thoroughly pliant. It is then allowed to become about half dry, next colored in any approved manner, and then given a good coating of boiled linseed oil applied upon the grain side only. This coat of oil is allowed to dry in thoroughly.

A bath is then prepared by mixing together Portland cement, borax and cold water in the proportion of eight ounces of cement, two ounces of borax and enough water to reduce the mixture to the consistency of milk. The leather is then placed in the bath. One pound of leather is allowed to so much of the bath as contains one-half pound of the cement and borax in a dry state.

The leather is allowed to stay in this bath for twenty-four hours,

then removed and examined by cutting its edge. If the mixture has not permeated the pores of the leather, the latter is returned to the bath. The longer it remains in the bath, the firmer and heavier it becomes. When the substance of the leather has reached a proper consistency, it is removed and allowed to dry. When nearly dry, it is given a good coat of linseed oil applied upon both the flesh and grain sides.

It is claimed for this process that sole leather treated as described has its durability increased from one hundred to two hundred per cent. and is made waterproof. It matters not whether the process be employed in connection with the complete leather or with leather in the process of tanning. The treatment appears to be equally efficacious in all cases. This process is patented by Hugh Mackay, of El Paso, Texas.

TANNING WITH GAMBIER, GOLDEN SEAL, ACID, AND SWEET FERN.

A composition of matter in connection with processes of tanning, and consisting of gambier, ten pounds; sulphuric acid, one pound; golden seal, in powder, one-half pound; sweet fern extract, two pounds; water, fifteen gallons, has been made the subject of a patent. The objects of this compound are to provide a tanning solution that will act speedily and effectively in tanning and dressing hides, and one that combines economy of ingredients with superiority over other compounds by reason of its penetrating properties and beauty of finish.

In preparing the mixture used as a tanning compound, the gambier is dissolved independently in water, and then put in mixture with the other ingredients by ordinary mechanical means, the sulphuric acid being the last ingredient.

The compound having the function of dressing the hides after passing through the tanning process is composed of the following ingredients: Soft water, six gallons; sulphuric acid, one-half pound; alum, one pound; corn starch, one pound. The first step in the process of treating the hides or skins is to immerse the same in the tanning mixture, and letting them remain for one-half hour, then exposing them to the air for fifteen minutes. Being again returned to the mixture, they are allowed to remain for about twelve hours longer, when they are again exposed to the air for a short period of time. This work is repeated three times in the next twelve hours, then once a day for about eight days, when the hides or skins will be sufficiently tanned to be subjected to the next part of the process. This is the dressing mixture, and in this the hides or skins are allowed to remain about one hour, then washed in clean water, and hung up until they have become about half dry. They are then pulled and washed until thoroughly dry, when they will be sufficiently dressed, and will come out white, soft and pliable. A slight change in the dressing process is adhered to in the treatment of furs or skins with the hair on. In such cases the

skins are immersed in the dressing compound, and let remain twelve hours; they are then taken out, washed in clear water, and hung up until half dry. They are then worked soft and pliable, and the fur or hair cleaned, and a fine finish is said to be obtained in this way.

TANNING WITH BARK LIQUOR, SALTPETRE, ALUM AND GLAUBER'S SALT.

Among the various processes that have been brought forward for the purpose of tanning leather with bark liquors in less time than is commonly consumed, is one by which the bark liquor is supplemented by a solution of saltpetre, alum and Glauber's salt.

It is well known that by the older methods of tanning the hides, after the hair has been removed, are placed in weak liquor, and for a period of from three to four months, are left in the same, with more or less frequent handling, and changing of the liquor, until finally they are tanned. Much care has to be exercised lest too strong liquor be used, in which case the tannic acid of the same will act upon the grain of the hides, rendering it crisp and brittle, materially impairing the value of the leather. By combining the above-named chemicals with bark liquor, they unite with the liquor in such a way as to render the action on the gelatine and fiber of the hide harmless, and at the same time admit of the hides remaining in the vats in which they are first placed until they are completely tanned.

The tanning liquor is prepared in sufficient quantity, either from oak or hemlock bark, of 18° or 20° strength of the barkometer to cover fifty skins, this being the usual number placed in each vat. To the liquor is added a solution made as follows: Four pounds of saltpetre, four pounds of alum, and five pounds of Glauber's salt, dissolved in hot water. After this solution has been added to the bark liquor, the skins are placed in the mixture, the skins and the mixture being agitated once an hour for the first twelve hours. After this has been done, they may remain in the liquor six days, unless they are very heavy, in which case they may remain eight days in the vat, at the end of which time they will be found to be thoroughly tanned. They are then to be washed, dried and finished in the usual manner, unless they are to be sold in the rough or made into sole leather, in which case they should be rinsed in a vat containing sufficient water, to which are added three pounds of cream of tartar. This does not enhance the value of the leather more than to give it a nice, clean, bright appearance. Patented by J. W. Hitt, Lisle, N. Y.

TURKEY-RED OIL IN TANNING AND OILING LEATHER.

In tanning leather of the various kinds and by the various processes the use of oil plays an important part, and the same has been applied in various ways, though principally as an emulsion with alkalies or their carbonates, or as an emulsion containing a free fatty acid. It has been found by Armand Müller, of New York City, that the whole tanning

process may be greatly improved, shortened and simplified by the use of sulpho-compounds, or mixtures of the sulpho-compounds of the various fats and oils with fats or oils or free fatty acids—that is, by the use of the so-called “Turkey-red oils” or “alizarine oils.” These oils are used in this process of tanning in place of fats or oils, or emulsions of oils or fats, whether in bark-tanning, alum-tanning or tawing, oil-tanning or chamoising, chrome-tanning, or any other in which oil or its equivalent is used.

The materials present ready means of effecting the proper absorption of oils and fats, in the shortest possible time, in the most rational manner and with a considerable saving of material. This refers as well to the manufacture of common tanned leather—that is, to ordinary bark-tanning, as to tawing and chamoising. Furthermore, the great advantages are presented that combinations may be effected that insure the tanning materials being more firmly fixed upon the fiber, resulting in much tougher leather. The benefit derived from the use of these oils is due to the fact that they are soluble in water, contain large quantities of undecomposed or unchanged oil, or free fats, or fatty acids, and present these in a manner and condition to permeate the skins with great ease and uniformity, thereby also effecting great saving in material and labor.

The oils or sulpholeates are to be produced in the well-known way, by the gradual action of twenty-five to fifty per cent. sulphuric acid upon triglycerides, oil-seeds, etc., as well as upon semi-liquid and fixed fats, with neutralization of the resulting acid sulpho-mixture by means of potassium or sodium hydrate, or ammonia.

A few examples of the methods of using the sulpholeates in tanning leather are given. First proceeding, upon hides to be bark-tanned. The well cleaned and properly swelled hides are placed in a neutral, five to seven per cent. sulpholeate solution. After the expiration of a few hours they are to be taken out, allowed to drip and to dry in the air or in a damp heated chamber, whereupon after complete drying they are washed, and the operation is repeated to completion. The remaining oil preparation can always be employed anew, without particular addition thereto. The hide thus prepared and nearly tanned is next placed in the tan vat in the usual manner, or may be subjected to any other process, as, for instance, to a process of quick tanning.

The hide with the usual quantity of tan stuff absorbed is tanned in half the time, is much better in quality and never brittle. The leather is now treated as usual, and fattened or oiled, though again in place of oil, fat or degrass, a six (greater or less) per cent. sulpholeate solution may be employed, and finally the hide is dried and washed. The washing, however, may be omitted. Second proceeding: The raw hides are softened, cleaned, swelled and tanned in the usual manner, and then instead of being smeared or stuffed with fats, oils or degrass they are passed through a seven to ten per cent. solution of the oils in lukewarm water, whereupon they are allowed to drip and are then slowly

dried. The leather is then at once bark-tanned, and may be colored with logwood with much finer effect than ordinary leather.

ALUM-TAWING WITH TURKEY-RED OILS.

The skins tanned by the usual process of tawing have the disadvantage that by water a part of the alum, clay, or argillaceous earth is withdrawn from them, whereby their strength is much reduced. This evil can best be overcome by the application of the sulpholeates, either before or after the actual tanning with alum and salt. The leather acquires by this treatment increased solidity, coupled with flexibility and softness and a finer appearance. The sulpholeate solutions are admirably adapted to replace the egg yolk used in the manufacture of kid gloves. To the oil solution, according to the French method, some phenol (carbolic acid) is added, although many other suitable soluble substances, such as salicylic acid, tar oil, etc., may be employed to counteract the too strong heating of the stuffed skins when laid or spread or stored to cure. The sulpholeates may also be used in the chrome process, resulting in increased solidity and toughness, together with softness and pliability, than results from the application of soap solutions.

OIL TANNING OR CHAMOISING.

The skins prepared in the usual manner are passed through a twenty-five per cent. Turkey-red oil solution, whereupon they are allowed to dry, are laid in a moderately warm room in a heap and carefully covered up. They are then hung up in the air and allowed to dry slowly, when they are again oiled in the same solution after they have been laid in lukewarm water to rid them of any adhering unchanged alkaline sulpholeate, are filled, again laid in a heap, again dried, and then treated with a weak solution of alkali. The dried leather is then stretched and rubbed to give it flexibility, which has been somewhat lost in drying, and is then completely oil-tanned.

The results may be variously modified, by greater or less concentration of the Turkey-red oil solution, by higher temperature in drying, as also by more frequent passes or dippings. In all cases the absorption of the fats and fatty acids takes place sooner, more evenly and with greater certainty than in the ordinary procedure; and there is no loss of fat, because the remainder of the solution may be applied with equal effect upon a fresh lot of skins. Combinations with the salts of alumina may also be employed here.

The method preferred is as follows: Steep the prepared skins in a solution containing preferably fifteen per cent. of the soluble oil; dry, and if necessary repeat the operation, and then proceed in the usual manner of tanning, according to the kind of leather wanted.

TANNING AND PLUMPING LEATHER WITH FORMIC ALDEHYDE.

The following process is a patented method of tanning, designed

for the final finishing of East India kips, goatskins, basils and white leather, and the improvement of hides and skins imperfectly tanned by cutch, terra japonica, divi-divi, etc., so that the required plumpness, weight, color, softness and moisture-resisting qualities are obtained.

The process consists essentially of two steps, the first of which is concerned with the introduction of materials which will render the skin sensitive to the fixing or tanning agent employed in the second step. This results in a fulling or plumping effect, clearing the grain, and at the same time feeding the leather. The first step has the same purpose as that commonly attained by the employment of old and sour liquors and weak solutions of extracts which precede the actual process of tanning.

The second step consists of treating the hide or skin to the action of formic aldehyde, a material possessing the property of fixing the connective tissue and fibers in the swelled and plumped, tawed or partially tanned condition, produced by the first treatment, and at the same time of fixing in, upon or between the fibers, materials previously supplied by the first step of the process to contribute special qualities, such as body, color, suppleness, weight, etc., essential to a solid and well-nourished leather.

The use of the formic aldehyde in the second step is not a mere aggregation of elements or materials, as it is in its nature and effects entirely different from the materials employed in the first step, and could not be substituted for them to produce the effects of the first step, while it possesses distinctive and positive characters by which it acts upon both the skin and the materials with which it has been impregnated by the first step in a manner peculiar to itself. The formic aldehyde is used in the second part of this process strictly as a tanning agent to render the skin non-putrescible and insoluble.

Advantage is taken of the property possessed by various tanning and tawing agents such as alum, salt, argol, eggs, flour, vegetable extracts, gambier, cutch and the artificial and natural tannins used in making leather, many of which have none or only feeble tanning properties—of causing a curling up or separation of the fibers, and the deposition therein and upon, of materials which prevent them from becoming agglutinated, thereby allowing the interlacing fibers to move readily upon each other, and which at the same time add material to the skin, which is of advantage in respect to weight, body, color, etc., whereby a plump, soft, pliable, tough and elastic leather may be produced.

Leather is of so many varied qualities and varieties that it is impossible to specify any one of the agents, such as alum, eggs, flour, extracts, gambier, tannins, etc., as being capable of meeting all requirements which will produce the effect or effects desired.

The following particular case will serve to illustrate the steps involved : Sheepskins, goatskins or hides, having been previously prepared for treatment by softening, unhairing and other necessary steps, usually referred to as “ beam-house treatment,” are placed in a drum or reel,

in which they may be agitated by the revolving of the drum, or the action of the paddles, or by any other suitable means. In the drum, for instance, is placed a solution of gambier extract sufficiently diluted to present the extract to the entire mass of skins, containing approximately four pounds of gambier to each one hundred pounds of wet hides or skins, the exact quantity of gambier being based upon the weight of the skins or hides to be treated, also upon their acidity or alkalinity, according to the well-known gambier process. The hides or skins are then drummed in the gambier bath until they are permeated through and through by the solution. When the gambier has struck through or thoroughly permeated the skins, which may be ascertained by cutting into the thickest skin and examining the exposed interior, they are cleansed in clear water; but this washing may be dispensed with and the second step proceeded with at once.

The second step consists in subjecting the skins to the action of formic aldehyde, preferably in solution, although it may be employed in the state of gas, either in the same drum or vat in which they were given the first treatment, or another drum or vat may be used.

The amount of the solution employed varies somewhat, but is based upon the weight of the skins to be treated, and it has been found in practice that three pounds of commercial forty per cent. formic aldehyde solution to each one hundred pounds of wet hides or skins is sufficient for ordinary sheep or goatskins. The amount of water with which the formic aldehyde is diluted is based upon the bulk of the skins, being just sufficient to keep them well wetted and to present the formic aldehyde to the entire mass of them, but not so much as to prevent the pounding action of the skins when revolving in the drum.

The skins are subjected to the action of the formic aldehyde until permeated through and through and until they respond to the usual tests of good leather. In this particular case the time required is three hours, depending to a very considerable extent, as in the treatment by the first step of the process, upon the number of skins in the drum and the rate and mode of agitation to which they have been subjected.

It is advisable to maintain the bath in the second step at a temperature of not less than 80° Fahr., and not above 120° Fahr., in order to secure the greatest efficiency from the formic aldehyde. After the skins are found to have been thoroughly fixed by the formic aldehyde, they are washed and are then ready for the usual treatment employed in finishing. In case the formic aldehyde is employed in the state of a gas, the following method is advisable: The skins, having been brought to the desired state by the first step, as has been described, an amount of commercial formic aldehyde solution, representing three pounds to each one hundred pounds of wet hides or skins to be treated, is placed in a suitable generator, and the gas generated is allowed to pass, by suitable connections, into the chamber containing the skins. The temperature of this chamber is preferably maintained at from 110° to 120° Fahr., and the atmosphere of the chamber should also be kept

moist, both of which conditions are readily secured by the admission from time to time of a small quantity of aqueous vapor by means of a suitable steam connection. The chamber employed should be a closed one, and no larger than necessary to allow the skins to be fully exposed to the action of the gas.

If desired, the gas may be admitted to the drum in which the preliminary treatment took place or into a similar drum, and the skins agitated therein, or they may be stretched on suitable frames and enclosed within a stationary chamber, in either case being exposed to the action of the gas until they respond to the usual tests for good leather, say for a period of six hours, the time depending, however, on the thickness and character of the stock under treatment.

The market supplies certain tanned or imperfectly tanned skins and hides, which have been subjected to the action of salt, alum, flour, eggs, vegetable extracts, gambier, cutch, tannins or other materials, and which do not constitute high-grade leather, but which may be greatly improved. The effects produced on these skins are analogous to those produced by the first step of the process, and it is advantageous to take such skins, and after softening them in water to proceed to treat them as described in the example cited for treating raw stock, whereby the results of the first step are secured with less time and material than is required in the treatment of raw hides or skins. In certain cases where the tawed or imperfectly tanned skins or hides have the plumpness, color, weight, etc., desired, and which would be in other instances secured by means of the first step of this process, the second step may be at once proceeded with, which consists essentially in the fixation of the natural or added constituents of the skins.

It has been found by a large number of practical tests that the action of the natural tannins as introduced into the skin by the first step of this process may be greatly hastened and augmented by the employment of formic aldehyde in conjunction therewith, as accomplished in the second step. Thus with the pyrogallol tannins, a considerable portion of which possess little or no tanning power, a compound is formed whereby all the tannin is rendered available, and consequently a greater action secured from a given amount of extract, a matter of importance in point of economy. Again it has been found that by means of formic aldehyde used in conjunction with, but subsequent to the use of those natural tannins containing "reds," as introduced into the hides by the first step of this process, these substances, which in many instances are insoluble and not directly available for tanning, can be fixed in the leather; and again with other tannins the deposit of "whites" or "bloom" is prevented. The peculiar action of formic aldehyde upon the fibers results in filling the skins—plumping them, thereby effecting what is commonly known as feeding the leather.

A special advantage afforded by this process is that it overcomes the obstacles hitherto encountered in the use of material like divi-divi, which add to the leather substances extremely susceptible to fermenta-

tion and which lead to loss of leather in damp weather. The superior bactericidal and anti-fermentative properties of formic aldehyde prevent this fermentation and the subsequent softening of the leather. It also prevents moulding during the drying of the finished leather.

Formic aldehyde has the property of fixing the collagen and other gelatinous constituents of the skin in the condition in which they are when subjected to its action ; and it has been found to be highly advantageous in using formic aldehyde in the manufacture of leather to prepare the hides or skins by some preliminary treatment of tawing or tanning. They may be alum, oil, chamois, chrome or vegetable tanned in the first part of the process, and then taken ready prepared and submitted to the fixing action of formic aldehyde.

Patented by Messrs. Dolley & Crank, Philadelphia, Pa.

LEATHER FOR HANDLE GRIPS.

A compound has been invented for the purpose of assisting in effecting a hand grasp, more particularly adapted to be used in connection with the handles of golf sticks, tennis rackets and similar instruments, whereby the handles are prevented from turning or twisting in the hand.

The compound is prepared in the following manner : To one ounce of glycerine add ten grains of powdered rosin and thoroughly mix the two ingredients together, after which the compound is left standing twenty-four hours before it is used, the ingredients to be mixed together while in a cold state. The preparation is then applied to the handle portion of the instrument, and as the handles are usually covered with leather or buckskin, it will be readily seen that the preparation will be absorbed by the leather, the rosin causing an adhesion between the hand of the user and the handle, thereby preventing the latter from twisting in the hand. This preparation further serves as a moistener that keeps the hands from becoming sore, insures an easy, compact grasp and preserves the leather. Its properties are lasting.

This compound has been patented by Anthony T. Johnson, of Mineola, N. Y.

PROCESS FOR RENDERING LEATHER WATERPROOF.

The following is given as a process for rendering leather waterproof :

A bath is made of about one pound of wax and half an ounce of oil of mirbane (nitrobenzol), which is an oily substance. After the wax has been melted in a hot-water bath over a fire the oily substance is added and thoroughly stirred in. In this heated bath the leather is immersed for from four to five hours, according to the degree of its hardness. The oil of mirbane has the quality of completely combining with the wax without leaving any fatty deposit upon the leather after the latter has been subjected to the second bath. It has been found that oil of bergamot is an equivalent to the oil of mirbane.

A second bath is prepared composed of equal parts of alcohol and benzine, which is also slightly heated. The leather taken out of the first bath is immersed in the second bath and subjected to its action for about half an hour. After removal it is dried in the open air and is then ready for use. The second bath will cause the wax to be removed clean from the surface of the leather, and practice has demonstrated that by the process described the wax will be retained within the pores of the leather. It is claimed that the leather has increased strength and durability when treated with this process, and poor leather is improved in quality.

This process has been patented by Charles Böhm, of New York.

CHROME TANNING WITH GLUCOSE, GLYCERINE, STEAM AND SACCHARINE
SUBSTANCES.

This process is designed to provide a metallic tanning of hides to produce a leather having the same capacity for finishing, working or use as bark-tanned leather, while retaining the toughness and durability of chrome-tanned stock.

It consists, broadly speaking, in introducing into the fiber of the hides in a substantially inactive chemical state, substances containing tanning matter adapted to be released by reaction between said compounds, and then establishing a condition under which said reaction will take place. Chromic acid is employed as the substance containing the tanning matter, and it is introduced into the hide in substantially the same form and manner as in the first bath of the ordinary two-bath process. After the hide has become thoroughly soaked and impregnated with the chromic acid a reducing agent is introduced, such as glucose, which does not act at once upon the chromic acid, but is what may be termed "chemically inactive" for the time being toward said acid. When the hide has become thoroughly soaked and impregnated with the glucose, it will be seen that the chromic acid and glucose are intimately and uniformly associated together and with the fibers of the hide. Thus, in effect, each molecule of the chromic acid is brought into intimate association with its molecule of glucose on the particular fiber upon which the product is to act before said product is released. Under these circumstances when the reaction does not take place, the chromic acid is deposited directly and immediately upon the hide fibers. As the chromic and glucose are uniformly distributed throughout the hide fiber, it will be seen that the chromic acid will also be uniformly deposited thereon and the interior fibers will receive their due proportion of the oxide.

In practice for one hundred pounds of hides, the first bath consists of six pounds of bichromate of potash or soda, four pounds of alum, four to six pounds of common salt, ten ounces of sulphuric acid, twenty ounces of hydrochloric acid, sixty gallons of water. The hides to be treated are prepared in the usual manner for tanning and allowed to soak in this bath until thoroughly impregnated with the chromic acid.

This will ordinarily take from twelve to eighteen hours depending upon their weight and thickness. They are then removed from the bath, set out and hung up until about three-fourths of the mixture in them has evaporated. When in this state, they are spread out and painted on both sides with a solution of glucose and packed in piles for from three to six hours to allow the glucose to soak in and become uniformly distributed throughout the hide. The glucose solution may contain from fifteen to fifty per cent. of glucose dissolved in water. If applied under ordinary atmospheric temperatures, there will be substantially no immediate reaction between the glucose and chromic acid, they being under the conditions applied in an inactive state toward each other. Thus the glucose will soak into the hide and thoroughly and uniformly associate itself with the chromic acid and hide fibers before any reducing action takes place. By painting the glucose solution onto the hide possible contact between the chromic acid in the hide and the glucose solution from which the painting supply is taken is prevented.

To prevent the glucose from souring in warm weather, use for three gallons of water, about a half pound of quassia chips, and a half an ounce of carbolic acid. The quassia chips are boiled together with the water and the carbolic acid added, and into this is stirred the glucose to make up the necessary strength of the solution.

In the chromic acid bath a small excess of sulphuric and hydrochloric acids tends to hasten the reduction. If a larger excess of acid be used the reduction will take place in a proportionately shorter time. Thus if it is desired to hasten the reduction, an excess of acid, preferably sulphuric acid, may be employed, but care should be taken that the excess of it is not enough to cause the reduction before the glucose is uniformly distributed through the hide or cause the acid to injuriously affect the hide fiber.

All organic substances have more or less reducing action on chromic acid, and an organic compound will generally be found preferable to employ as a reducing agent, since its action is generally slower. However, even an inorganic reducing agent may be employed if the proper conditions are obtained for preventing immediate reduction. After the hides have been uniformly impregnated with the chromic acid and glucose a condition is established under which the reaction between said substances takes place to release the chromic oxide or tanning substance. This condition may be established in a number of ways, but it is preferable to use a bath of hot grease for this purpose. After the hides have been treated with the glucose solution and about one-fourth of the moisture has evaporated therefrom, they are immersed in a bath of hot grease, the proportions of the ingredients of this bath being dependent upon the purposes for which the leather is to be used.

For the production of a suitable sole leather make up a bath as follows: One hundred pounds of stearic acid, twelve and one-half pounds of carnauba wax, six and one-fourth pounds of vaseline, six and one-fourth pounds of beeswax. This grease bath is reduced to a liquid and

kept at a temperature between 85 degrees and 90 degrees Centigrade (185 and 194 degrees Fahr.), and the hides are suspended in this bath until the grease has thoroughly penetrated the thickest parts of them. This will be found to take only a comparatively short time, an hour or more being all that is necessary. The effect of the hot grease is to establish a condition under which the chromic acid is thoroughly reduced and at the same time the hide is thoroughly filled with grease. For sole leather the hides are then rolled and finished in the usual way. For harness leather the proportion of vaseline in the stuffing bath must be increased to make the leather as soft as wanted—say twenty-five pounds of vaseline instead of six and a quarter pounds as above stated. To obtain the best results the glucose should be kept at about 50 degrees Centigrade (122 degrees Fahr.).

While this process attains its greatest utility in tanning thick or heavy hides, it may also be used to advantage for thin ones, and will be found to produce a high grade of uniformly tanned leather.

Another process quite similar to the foregoing one is carried out as follows: The hides are prepared for tanning in the usual way and then placed in a chromic acid bath until they are thoroughly permeated with the chromic acid. This bath may consist of four pounds of bichromate of potash, four pounds of hydrochloric acid and from four hundred to six hundred pounds of water, which will form a chromic acid bath as will be readily understood by those skilled in the art.

When thoroughly permeated with chromic acid the hide is subjected to a bath of an organic reducing agent, such as glycerin or glucose, or some other saccharine substance. The proportions of this bath may be five pounds of glucose or other reducing agent to five pounds of water. Allow the hide to become thoroughly saturated with this solution, which will take about thirty minutes.

Under the conditions of application there will be no substantial reducing action between the chromic acid and glucose for a considerable length of time, so that the glucose will uniformly penetrate the hide before any substantial reduction takes place. This permits intimate and uniform association between the chromic acid and glucose before reduction, so that when reduction does take place the chromic oxide is uniformly deposited on the fibers of the hide. Thus it will be seen that the two substances, glucose and chromic acid, are introduced into the fiber of the hide in a substantially inactive chemical state, and become intimately and uniformly associated together and with the fiber before reduction takes place.

The next step is to remove the hides from the glucose solution and subject them to a bath of hot vapors, such as steam not under pressure. This may be done by hanging them in a room containing steam. A convenient method for introducing the steam is by means of pipes arranged in any convenient manner in the chamber and provided with holes in their walls adapted to permit escape of the steam into the chamber. The hides are left hanging in the steam chamber until the chromic

acid has been thoroughly reduced. With thin stock this would take about one-half hour, and with thicker hides a proportionately longer time. The effect is to cause the chromic acid to be reduced to chrome oxide, and the conditions are most favorable for causing that oxide to combine thoroughly with the gelatinous substances of the hide. The water vapors present serve to maintain the softness of the hides during reduction. The latter taking place uniformly throughout the hides will cause a uniform deposit of chrome oxide on the fibers and consequently a uniformly tanned leather.

After the hides have undergone this step they are marketable leather which does not need any further stuffing to make it retain its plumpness. It is suitable for such purposes as belting, upholstering and enameled goods. In cases where it is desired to have a greased leather it may be stuffed in the ordinary manner.

A third process in which glycerine takes the place of glucose is as follows: The first bath consists in impregnating the hides with chromic acid. There are various ways of doing this, but a bath made of four pounds of bichromate of potash and four pounds of hydrochloric acid to four hundred to six hundred pounds of water is a preferred method. This bath is sufficient for one hundred pounds of hides; or in place of it a bath of four pounds of bichromate of potash, three pounds of sulphuric acid and three pounds of alum to the same amount of water may be used. The hides are left in this bath from twelve to forty-eight hours, in direct proportion to their thickness. When thoroughly saturated they are removed from the bath and hung on horses or racks to drain until about one-fifth of the moisture in them has run off or evaporated. They are then slicked out and given a coat of glycerin. Apply this in its undiluted commercial form, but glycerin of a different state of purity or dilution may be employed. The amount of it used is preferably slightly in excess of that which is absorbed by the hide under treatment. However, under the conditions of application there will be no substantial reducing action between the chromic acid and glycerin for a considerable length of time, so that the glycerin will uniformly penetrate the hide before reduction takes place. The hides are then laid one upon the other in piles in a flat condition and allowed to remain thus from twelve to forty-eight hours, according to their thickness. At the end of that time the chromic acid will then have been thoroughly reduced. The reduction taking place uniformly throughout the hide causes a uniform deposit of the chromic oxide on the hide fibers, resulting in a uniformly tanned leather. The hides are then washed, dried and stuffed in the usual manner, depending upon the kind of leather that is being made. While it is preferable to use glycerin to coat the hides after they have been removed from the first bath any saccharine solution of rapid penetrating power might be employed, varying the strength of the solution according to the thickness of the hides and the length of time they are allowed to remain in the bath. This saccharine solution may be made of any of the usual forms of sugar

and is preferably applied at or near the point of saturation, although a weaker solution may be used with good results. In this case also the amount applied is preferably slightly in excess of that which is absorbed by the stock under treatment. The hides should be allowed to remain in the solution from ten to twenty minutes. After having been removed from the saccharine solution they are piled up flat and allowed to remain thus until the chromic acid has been reduced, which takes from two to three days. They are then washed, dried and stuffed as above described.

It has been found that with the hides treated by this process the tannage or the reduction of the chromic acid to chromic oxide takes place uniformly throughout the hide fiber, making a leather which is firm and pliable and devoid of gristle or untanned portions, and the exterior of which is not brittle or liable to crack.

William G. and Albert C. Roach, of Cincinnati, Ohio, have patented the above described methods of tanning, the patent having been assigned to the Cincinnati Chrome Leather Company.

NEW METHOD OF CHROME TANNING.

This process is nearly identical in its manipulations with the regular two-bath process, as will be seen by the description. It can be executed in two baths or one bath.

DIRECTIONS FOR ONE BATH.

Use bichromate of potash 4 per cent. of the weight of the skins.

" muriatic 20 degrees Bé. 3 per cent. of the weight of the skins.

When the skins are thoroughly impregnated with this liquor and seasoned, add to the bath, while the skins are in motion, of

S. Z. solution 20 per cent.

S. K. solution 35 per cent.

These solutions should be mixed before adding them to the bath. Then add, the skins being in motion,

Sulphuric acid, 66 degrees Bé. 5 per cent.

Before adding the acid, mix it with about thirty times or more its weight of water. Then add this mixture through a lead-lined wooden funnel, long enough to reach to the bottom of the vat, and at one corner of it, while the goods are in motion.

After about one and a half days the skins are done. No damage will result to them should they remain a longer time in the liquor. When done, wash and finish them. This tannage produces a finer grain, less contracted, besides sulphur, as in the "hypo" process, is not present.

Skins by this tannage are pre-eminent for making enamel or patent-finish leather.

PROPORTION OF MAKING SOLUTIONS.

For S. Z. solution use nitrite of soda.....	80 pounds.
Hot water.....	84 pounds.
For S. K. solution use chloride of lime (fresh).....	48 pounds.
Soda ash.....	48 pounds.
Hot water.....	384 pounds.

For S. K. solution dissolve the soda ash in hot water. When all is dissolved add through a sieve the chloride of lime, keeping the liquor always well stirred. When all the lime is stirred in, leave the liquor at rest until it becomes clear, say two days, then draw off the clear liquor for use as above, and throw the sediment away.

Both liquors S. Z. and S. K. may be kept in one vessel—carboy, vat or hogshead—provided the properties are kept up, and when wanted for use the proper quantity is taken out. A wooden tank or hogshead should be used for making the solution.

In place of solutions S. Z. and S. K., as above, peroxide of sodium with sulphuric acid may used. To each hundred gallons of water in the vat, add five pounds and five ounces sulphuric acid, 62 degrees Bé.; stir well; then add, sifting in, four pounds of peroxide of sodium in small quantities; while stirring well; use hand-warm water for the bath. After this bath is ready put into it the previously chromed skins, and paddle them until they are tanned.

THE SCHULTZ PROCESS OF CHROME TANNING.

In the practical application of the original Schultz process the skins are tanned in the following manner: The first bath consists of four pounds of bichromate of potash and two pounds of muriatic acid in sufficient water to enable them to process nicely. The quantities of bichromate of potash and acid mentioned are for every one hundred pounds of skins, weighed as they come from the preparatory processes. The bichromate of potash is first dissolved in hot water, and then the muriatic acid is added. This first bath may be applied to the skins in a drum or in a vat. When a drum is used, from ten to fifteen gallons of water are required for every hundred pounds of skins, and they are drummed in the yellow chrome liquor until thoroughly impregnated with it, when the first bath is completed. When a paddle vat is used, enough water is required to cover the skins, so that they are allowed to float and turn in the liquor by the action of the paddles. Both methods are employed. The drum method is, however, usually preferred, as the results are accomplished in shorter time. It is highly important that the skins are thoroughly impregnated with the chrome liquor, in order that they may be completely tanned in the second bath. The length of time consumed by the first bath depends upon the thickness of the stock. Very light sheep- and goat-skins require only a short time, sometimes less than an hour, while heavier goods need longer time.

When the skins are removed from the liquor, the strength is not usually exhausted, and the liquor may be used for another lot of skins by strengthening it up with bichromate of potash and acid. When bichromate of potash is acted upon by muriatic acid, there results chromic acid and chloride of potash. The latter does not assist at all the tanning, neither does it do any harm. While the skins are saturated with chromic acid, they are in a very sensitive condition, and require careful and intelligent handling. They should not be exposed to the air or strong sunlight, but kept protected until they are placed in the second bath. The practical object of soaking or drumming the skins in the chromic acid liquor is to have the chromic acid in them when they go into the second bath, in which the actual tanning takes place. After the first bath is completed and the goods are removed from the liquor, they should be left in piles for a few hours, in order that the surplus liquor may drain off, or they may be pressed or struck out, and are then ready for the second bath.

The original formula for this part of the process was ten pounds of hyposulphite of soda and two and one-half pounds of muriatic acid for every one hundred pounds of skins. The hyposulphite of soda is dissolved in hot water and then the muriatic acid is poured in and the solution is well stirred, and then incorporated in the required quantity of water. This part of the process is usually done in paddle vats. The skins are left in the liquor until the yellow color has entirely disappeared and they have assumed a pale bluish color through the thickest part of the heaviest skin, which is perceived by cutting. By the time this has been accomplished the skins are tanned and may then be removed from the liquor and washed thoroughly, and then finished. For the second bath it is good practice to make up a liquor by using only half of the quantities named, and after the sulphur smell has become faint and the skins seem to have absorbed all the sulphurous acid, to add the other half of the materials used and leaving them in until they are entirely leathered. Good results are also obtained by dipping them as they come from the press or the striking machine after the first bath, in a weak solution of hyposulphite of soda and acid. By this method they are not subjected to the strong solution at the start, which sometimes causes a rough grain and closes the pores, which are especially undesirable on grain-finished leather.

The quantities of hyposulphite of soda and muriatic acid required by a lot of skins depend somewhat upon their condition when they go into the second bath. Usually it requires two and one-half times as much hyposulphite of soda as of bichromate of potash used. The work of the second liquor can be accomplished in a few hours, although the best results are obtained when the goods are left in the liquor over night. They may go into the liquor, say at four o'clock, and be paddled until six o'clock, and after lying in the liquor over night, may be paddled a short time in the morning, and will then be thoroughly tanned. It is never productive of the best results to hurry the skins.

The longer time they are given in both the first and the second bath, the better will be the final result.

The muriatic acid acting upon the hyposulphite of soda causes the formation of sulphurous acid, sulphur, and chloride of sodium. The sulphurous acid thus formed is the active agent of the bath, and by its action upon the chromic acid of the first bath with which the skins are impregnated, causes the formation of chromic oxide throughout them, and this results in leather. Skins can also be tanned by reversing the usual order, and first soaking them in the liquor of hyposulphite of soda and acid, and then applying to them the chrome liquor. The time consumed is considerably shortened when the liquors are used at a temperature of about ninety degrees Fahr. For chemical reasons it is necessary when tanning with this process to use enough muriatic acid in the first bath to liberate all the chromic oxide. In consequence of this, and because the tanner does not always understand the process and fails to properly adjust the proportions, there is an excess of muriatic acid used which remains as such in the liquor not in combination with the bichromate of potash. This results in injury to the leather. Chromic acid is frequently used by tanners in the first bath. In this case, no muriatic acid is required; only so much chromic acid is taken as of bichromate of potash, *i. e.*, if a tanner would use four pounds of potash and two pounds of acid he would require, to accomplish the same results, four pounds of chromic acid and no muriatic acid at all.

METALLIC ZINC IN CHROME TANNING.

The following description relates to an improved process of chrome tanning, by which some economy and other advantages are obtained. The beam-house work for this process is the same as for any other process of chrome tanning. The tanning is also practically the same, with the exception that in this process a continuous evolution of nascent hydrogen is provided for in the second or reducing bath. The nascent hydrogen operates to change the sulphurous acid present in the second bath into hyposulphurous acid, which is a very powerful reducing agent, and also possessed of other advantages that will be mentioned and described later on. In this process of chrome tanning the hides or skins are first subjected, in the usual manner, to bichromate of potash or of soda, dissolved in water to which an acid, such as hydrochloric acid, is added. The first bath of the process is usually made up, for each one hundred pounds of skins, of about five pounds of bichromate of potash or of soda, and two and one-half pounds of hydrochloric acid of 21 degrees Bé., or an equivalent amount of sulphuric acid, the quantity of water used being sufficient to properly cover the stock. The hides or skins are treated to this liquor until they are thoroughly impregnated with the chrome compound, and are then removed, pressed or struck out, to remove surplus liquor, and are ready for the second or reducing bath.

The difference between this process of tanning and the regular chrome process, is in the manner of reducing the chromic acid in the skins to chromic oxide in the second bath. This second bath usually consists of hyposulphite of soda, muriatic acid and water. The action of the acid upon the hyposulphite of soda is to cause the generation of sulphurous acid and sulphur. The active agent in this bath is the sulphurous acid which quickly penetrates the hides or skins, while sulphur is also deposited in the fibers of the grain and flesh sides. The sulphurous acid is very corrosive, and together with the sulphur clings most tenaciously to the leather, so that after the tanning is completed the latter requires a very thorough washing to rid it of these objectionable materials, which, left in the stock, cause serious damage to it. The use of the ordinary reducing bath of sulphurous acid has therefore some very unpleasant features. It is the object of this improvement to overcome the unpleasant features by causing a continuous liberation of nascent hydrogen in the bath, the effects of which are to convert the sulphurous acid into hyposulphurous acid. This result is accomplished by the employment of metallic zinc in the bath. This is very simply and economically achieved by placing a number of pieces of zinc in the paddle or reel containing the bath, they being sufficiently large and heavy to remain at the bottom of the reel. The action of the acid bath is to liberate nascent hydrogen from the metallic zinc. Other methods of accomplishing the objects of this process may be employed.

For the treatment of one thousand pounds of skins, the inventor recommends a bath of one hundred and twenty-five pounds of hyposulphite of soda and fifty pounds of muriatic acid in six hundred and fifty gallons of water, and to this bath are added sixty pounds of metallic zinc. The zinc should be allowed to remain when the liquor is drawn off after the bath is exhausted and a new bath is prepared, and about five pounds of it should be added once a week. Instead of pieces of zinc being used in the liquor, the vat or reel may be lined with sheet zinc and thus a large surface be exposed to the action of the acid liquor. In place of hyposulphite of soda and acid, a solution of bisulphite of soda is sometimes used to accomplish the work of the second bath. When this material is employed, no muriatic acid is required, as the bisulphite of soda is charged with sulphurous acid gas. The quantity of this material used may be the same as of hyposulphite of soda, and the metallic zinc may be employed in a bath prepared in this way in the same manner as has been described. No sulphur is evolved in such a solution, but the nascent hydrogen is none the less an advantage, as it lessens the quantity of bisulphite of soda that is required by changing the sulphurous acid into hyposulphurous acid. It is customary, after the skins are taken from the first chrome bath and pressed or struck out, to dip each one singly into a dilute solution of hyposulphite of soda and muriatic acid, this treatment being for the purpose of accomplishing a slight surface reduction, and thus bringing the stock into the best condition for the reducing bath. A vessel lined

with zinc may be advantageously used to contain the liquor into which the skins are dipped, or pieces of zinc may be added to the solution, as the nascent hydrogen which will thus be developed will increase the efficacy of the solution. Less hyposulphite of soda will be required and less sulphur will be developed.

The advantages of this method of tanning are that a comparatively small amount of sulphur is liberated, and little or no sulphurous acid brought into contact with the skins or hides, so that when the latter are taken from the reducing bath, very little washing is necessary to perfectly cleanse them and make them quite neutral and in good condition for the subsequent finishing operations. In this way material economies of time, labor and apparatus are gained. By this method of evolving hyposulphurous acid in the bath, which is a more powerful reducing agent than sulphurous acid, less hyposulphite of soda is required than in the acid process. The quantity of hyposulphite of soda used may be reduced one-half, that is to say, where twenty per cent. of the weight of the skins of hyposulphite of soda have been used, and five per cent. of muriatic acid, ten per cent. of hyposulphite of soda and five per cent. of muriatic acid will suffice in this method of tanning. On a large scale this means a considerable saving.

Patented by W. M. Norris, Princeton, N. J.

TANNING WITH CHROMIUM CHLORIDE AND CHROMIUM HYPOSULPHITE.

The following description relates to a method of tanning in a single operation, such process constituting what is known to the trade as a one-bath chrome process. The tanning compound used consists of the ingredients hereinafter named in about the proportions stated : Bichromate of potash, one pound ; hydrochloric acid, two pounds and four ounces to three pounds ; hyposulphite of soda, two pounds and eight ounces to three pounds ; water, one gallon.

The hydrochloric acid used is of the usual commercial strength, about 21 degrees Bé. The hyposulphite of soda is in a crystalline state, and if it is dissolved before being added to the other ingredients the quantity of water used for such solution should be deducted from the amount stated above. The solution made according to the above formula constitutes the stock solution.

To make a tanning bath of the proper strength, one gallon of the stock solution is diluted with about five gallons of water.

The reaction of the ingredients used in this tanning liquor produces chromium chloride and chromium hyposulphite, the latter, however, being present in comparatively small proportion. The changing of the skins into leather is the result of the combined action of these two tanning agents upon them, such action, the inventor claims, yielding a better leather than hitherto produced by other chrome processes. The process is mainly intended for use in the tanning of calfskins. When tanning stock of a fine or delicate quality, such as is used for making

glove leather, it is preferable to reduce the strength of the hydrochloric acid by adding to it eight ounces of water, in which one ounce of bicarbonate of soda has been dissolved, or by dissolving one ounce of bicarbonate of soda in eight ounces of water and adding this to one gallon of the stock solution, which may afterward be diluted by the addition of five gallons of water to form the tanning liquor.

This process is patented by A. J. Pilar.

TANNING WITH CHROMIC SALT.

In this process of chrome-tanning the hides or skins, after being prepared in the usual manner for tanning, are impregnated with a solution of chromic acid or chromic acid compounds in a vat containing the solution and then placed in a second vat, where they are subjected to the action of a solution of a chromic salt, sometimes termed "chromic-oxide salt," preferably chromic chloride, either neutral or basic, which gradually replaces the chromic acid or chromic compound in the hide or skin, and, being rendered insoluble in or upon the fiber, produces a superior quality of leather.

The chromic acid which is displaced slowly diffuses into the surrounding bath liquor. The solution of chromic salt, which may be hereinafter referred to as "chromic chloride," is contaminated by the chromic acid diffused from the skin, and this contamination would present an obstacle for the carrying on of this process on a commercial scale, owing to the excessively large quantity of chromic chloride which would be required to effect the tanning, if provision were not made to neutralize or offset the contamination of the chromic chloride solution by the diffused chromic acid, so that the tanning could be effected in a substantially small apparatus and with a small quantity or volume of chromic chloride. This result is effected by renewing or practically purifying the contaminated tanning solution, which is accomplished in a separate chamber or vessel connected with the tanning vat, so that the contaminated solution may be caused to pass through the purifying or converting chamber or vessel and then back again into the tanning vat, the said contaminated solution on its passage through the purifying chamber being freed from the contaminating chromic acid and restored to its original or normal chromic condition. This renewed chromic solution on its admission into the tanning vat becomes again active in tanning the skins. The chromic acid which contaminates the chromic solution may be disposed of by the action of any well-known reducing agent, but preferably by exposing it to the action of any oxidizable metal, such as zinc. To insure rapid action, the zinc is used in a fine state of division and in the presence of more or less acid, such as hydrochloric acid, or it is made strongly electropositive by contact with gas carbon or copper, or by means of an outside source of electricity. The zinc is preferably located in the purifying chamber or vessel. The inventor prefers that the zinc or oxidizable metal in the purifying

chamber should be connected with pieces of electronegative metal. The use of gas carbon is preferred in contact with granulated zinc or with grids or bars of the latter metal to insure a prompt and energetic action on the contaminated chromic solution. The zinc in the purifying chamber may be kept active or in an energetic condition by means of a free acid, preferably hydrochloric, which is supplied to the chamber in such small quantities as will permit it to be practically exhausted by combining with the zinc before it passes, with the renewed chromic solution, from the purifying chamber into the tanning vat containing the skins. The chloride of zinc incidentally produced in the purifying vessel, and which may be carried over into the tanning vat, does not appear to have any injurious effect upon the skins.

Tanning is done in a vat having connected to it near its bottom the inlet pipe of a pump, which may be of any suitable construction. This pump has its outlet pipe extended over the upper end of a vat, chamber or vessel provided with a perforated false bottom, upon which is placed a layer of zinc and preferably a layer of gas carbon, or a bed composed of a mixture of these materials. The vessel at its upper end is provided with a sieve or strainer of any suitable construction, and upon which the liquid from the outlet pipe for the pump is discharged. The vessel constitutes the purifying chamber, and is provided with an outlet pipe connected to it below the false bottom and extended upwards preferably above the level of the layers of zinc and gas carbon, and terminates above the top of the tanning vat, so that the liquid passing through the chamber may flow back into the tanning vat. The vat should be provided with an agitator or paddle wheel by which the skins may be kept in motion. The purifying chamber is adapted to being supplied with free hydrochloric acid from a supply tank or vessel, provided with a discharge pipe, having a cock or valve by which the supply of free acid to the chamber may be controlled.

In the operation of the apparatus the hides or skins to be treated, after being first impregnated with a solution of chromic acid or its compound, as now commonly practiced (and which solution may be composed of about five per cent. of bichromate of potash to the weight of the skins, and from two to three per cent. of thirty-five per cent. hydrochloric acid), are removed from the chromic acid bath and placed in the chromic chloride solution contained in the tan vat, when an examination of the thicker parts of them in the chromic acid bath shows thorough penetration of the chromic acid solution. The chromic solution may be made by dissolving commercial soluble chrome green or hydrated oxide of chromium in a minimum amount of hydrochloric acid, and making up the bath by an addition of water to a strength of about a four per cent. solution of chromic chloride, or the bath may be made by passing a solution of bichromate of potash, to which hydrochloric acid has been added, through the vessel or container and diluting the bath to an extent to form about a four per cent. solution of chromic chloride in the vat. Common salt is preferably added to the

solution in the vat in about the proportion of two parts salt to one part of chromium chloride to prevent the drawing of the grain and to facilitate diffusion.

The skins saturated with the solution of chromic acid are kept in motion in the tanning vat by the paddle, and while in the vat the chromic acid contained in them diffuses into and contaminates the chromic chloride solution and imparts to the originally green chromic solution in the vat a yellowish-green tint. The solution thus contaminated is carried by the pump to the purifying chamber or vessel and is discharged from the pipe upon the sieve, which serves to prevent the passage of foreign bodies, such as loose animal fiber, hair, etc., and their coming into contact with the layers of gas carbon and zinc, through which the yellowish-green contaminated tanning solution percolates or passes and becomes freed from the contaminating chromic acid, and is converted into a purified chromic solution having nearly or quite an emerald-green color. This purified chromic chloride solution passes through the pipe back into the tanning vat, where it again becomes energetic and acts upon the fibers and is distributed with great uniformity through the skins, replacing the chromic acid, which gradually diffuses out of them. This cycle of operations is continued until the skins have been properly tanned, and during the operation their color passes from yellow to yellowish-green, then to sage-green, and finally to blue. When the thicker parts are colored blue throughout, and pieces cut from them resist the action of boiling water without strong contraction, the tanning is completed.

By this process the chromic compound is uniformly distributed throughout the thickness of the skins, the grain is very perfectly preserved, and strong and supple leather produced. The time required for tanning depends upon the thickness of the stock, the strength of the tanning solution and the activity of the purifier. Goatskins can be tanned in twenty-four hours. The tanning bath may be used for a long time, and many batches of stock can be tanned in the same solution. It may be strengthened occasionally in case the chromic acid which diffuses from the skins is, when converted in the purifier, insufficient in quantity to replace the chromic compound absorbed by them, and so also a portion of the contaminated solution in the vat may from time to time be removed, so as to decrease the amount of zinc chloride and other substances which may collect in the solution. Furthermore, it is not necessary that the circulation be maintained through the purifier throughout the period of tanning, for if after running the pump and paddle twelve hours or less, the yellow color has disappeared from the stock and from the tanning solution, the skins will continue to tan while the machinery is at rest.

In order that the process may be clearly comprehended, one set of proportions of ingredients used is set forth as follows: One hundred and fifty pounds of bichromate of potash, one hundred and fifty pounds of common salt, and six hundred gallons of water are placed in the

tanning vat. In the purifier are placed two hundred pounds of granulated zinc and six hundred pounds of comminuted retort carbon, and in the acid container above the purifier seven hundred and fifty pounds of 35 per cent. hydrochloric acid. The pump is then started and the circulation of the liquor in the vat established through the purifier, and at the same time the valve at the bottom of the acid container is opened to supply the acid to the purifier in a slow stream. When the solution in the tan vat has lost its reddish color and has become emerald green, the chloride solution is in proper condition for the reception of the skins, which to the weight of fourteen hundred pounds can be floated in the above bath. During the process of tanning additional hydrochloric acid is supplied to the acid container and permitted to run slowly into the purifier.

This process of chrome tanning was invented and patented by Henry Carmichael.

TANNING WITH A CUPROUS SALT.

This method of tanning is a process for the making of chrome leather and consists of subjecting the hides or skins to a liquor containing a chrome salt, and then treating them with a solution containing a cuprous salt. One hundred pounds of hides or skins are prepared for the process in the usual way. Then they are immersed in a solution of five pounds of bichromate of potash and two pounds of salt, which are dissolved in five gallons of water, to which two and a half pounds of hydrochloric acid are added. They remain in this solution until they are thoroughly penetrated with the liquor, which usually takes from three to five hours, but in the case of thin skins less than three hours are required. Either drums or paddle vats may be used, the same as for any process of chrome tanning. The surplus liquor is then removed by pressure or by striking out on a machine. The second bath of this process differs from all other two-bath processes by reason of its being made up of sulphate of copper, salt and alum. For every two hundred pounds of hides or skins to be treated, five and one-half pounds of sulphate of copper, thirty pounds of common salt, and six pounds of alum, dissolved in twenty-five gallons of water are used. This solution is run into a closed vat containing copper cuttings, and is left to stand upon them until the solution has become almost colorless, which indicates that the cupric salt is reduced to cuprous salt, which is kept in solution by the presence of the common salt. This solution is now ready for use, and the hides or skins are immersed therein. As soon as they are immersed in this solution their previous yellow color is rapidly changed into a greenish-blue color, as they contain chrome as well as copper, after which they are ready for further treatment.

In preparing the copper solution, cupric chloride may be used in place of cupric sulphate; also, in place of common salt, any other neutral substance which is known to be a solvent of cuprous chloride

may be employed. The solution once used may from time to time be reinforced by the addition of such substances as have disappeared from it partly or wholly by being taken up by the stock. The solution may, after being treated with metal copper, be again used for another quantity of hides or skins. The solution that cannot be used any more, may be freed from copper by running it into tanks containing scrap-iron, on which the copper is precipitated.

In place of treating the skins first with a chrome solution, the copper solution can be first applied to them prepared for the process, after which they may be treated with the acidified bichromate of potash solution.

Patented by H. Endemann, Brooklyn, N. Y.

REDUCING WITH HYDROGEN DIOXIDE.

When skins are saturated with a chromate such as bichromate of potash and an acid such as muriatic acid, and then submitted to the action of a reducing agent sufficiently strong and rapid in its action, chromic oxide is separated out through their bodies, and leather results. This is the principle of the two-bath chrome process. To accomplish the reduction of the chromic acid with which skins are impregnated when they come from the first bath, a number of agents have been proposed and used.

In the foregoing processes, hyposulphite of soda in the presence of muriatic or sulphuric acid has been the reducing agent. Other reducing agents that have been proposed are hydrogen sulphide, either as gas or evolved from a metallic sulphide in connection with an acid, such as ferrous sulphate, cuprous sulphate or chloride, oxalic acid of greater or less activity. A two-bath process in which the skins are saturated with bichromate of potash and muriatic acid, and the chromic acid in them reduced to chromic oxide by the use of hydrogen dioxide, is carried out in the following manner: The hides or skins are prepared for tanning in the usual way, that is, they are limed, unhaired, bated and washed, or pickled stock may be tanned in the pickled state. The first part of this process, as with all two-bath processes, consists of a liquor composed of bichromate of potash and muriatic acid in the proportions of five pounds of the former, and two and one-half pounds of muriatic acid of 21 degrees Bé. for each hundred pounds of stock. This is applied to the hides or skins in a drum and the drumming continued until the yellow liquor has penetrated every fiber of the thickest skin. The second part of the process consists of a dilute solution of hydrogen dioxide. In this bath the color of the stock is changed as the reduction proceeds, from yellow to greenish-blue, something of a slate color. For this method of reducing the chromic acid to chromic oxide, the claims are made that there is nothing foreign or injurious added to the stock during tanning to seriously affect the finished product.

This is an important advantage over all other reducing agents. There is no separated sulphur that requires prolonged washing out, as with the use of hyposulphite of soda and acid; no sulphuric acid is formed by the oxidation of the reducing agent, and no oxides of iron or copper formed to affect the character of the leather. In this process the reduction is very rapid, much more so than when other agents are used, and the bichromate is changed in the hides before it can bleed or diffuse out, as sometimes takes place with reducing agents of slow power. It is not necessary to have the hydrogen dioxide ready prepared in solution, but the same results are obtained by the use of such peroxides as will produce hydrogen dioxide with dilute acids, as barium peroxide, sodium peroxide and others of similar properties. The bath of hydrogen dioxide is kept slightly acid with muriatic or sulphuric acid, and the hydrogen dioxide or metallic peroxide for its generation is added in small successive portions, so the mutual decomposing action with the chromic acid in the skins goes on steadily, but without loss of oxygen from the decomposition of the dioxide in the bath. During this part of the process the hides or skins should be kept in motion, so that not only will they be uniformly exposed to the liquor, but will be freed from the oxygen gas which escapes from the surface in minute bubbles. A point of importance to be noticed in connection with the second bath is that no metallic surfaces be exposed to the action of the solution. Vats made only of wood should be used, as otherwise considerable hydrogen dioxide will be decomposed and lost without doing its work upon the stock. At first the yellow chromed skins turn a decided blue color in the reduction bath, but this does not affect the result, as it soon disappears when the green color of the reduction shows itself. The color gradually changes from yellow to greenish-blue, as is the case in all chrome processes of tanning.

The reducing bath for this method of tanning may be prepared with sodium peroxide instead of hydrogen dioxide, as has been already suggested. In practice this is accomplished by heating one hundred gallons of water to ninety degrees Fahr. This water is acidified by the addition of five pounds and five ounces of sulphuric acid of a strength of sixty-six degrees Baumé. The acid should be well stirred throughout the water, and then are added, by being slowly sifted in, four pounds of sodium peroxide, the liquor being constantly stirred. When all the sodium peroxide has been added, the bichromated skins, after draining or pressing, are entered into the liquor and stirred about until the reduction of the chromic acid is complete and they are tanned, which can be readily seen by the tanner. The skins may be paddled for an hour or two, then left still in the liquor over night and paddled again for a short time the next morning. The process may also be completed in less time than this, according to the necessity of hurry and thickness of the skins. Before coloring and drying out, the leather should be thoroughly washed.

Patented by Samuel P. Sadtler, Philadelphia.

REDUCING WITH SULPHATE OF IRON AND ACETIC ACID.

Among the various processes used to accomplish the changing of the chromic acid in skins into chromic oxide is one by which the reduction is accomplished by the use of sulphate of iron in combination with acetic acid. In carrying out this process, the skins are prepared for tanning in the usual manner, and are then immersed or treated in a drum with a solution of chromic acid. This may be composed of bichromate of potash and muriatic acid in the regular way, or of chromic acid in powder form dissolved in water without the muriatic acid. Some acetic acid is added to the liquor. This liquor is composed of the usual proportions, and the skins are saturated with it until they are thoroughly impregnated with it, the length of time depending upon their thickness. When the chrome liquor has thoroughly penetrated the skins they are pressed or are drained until they are freed of the surplus liquor. Then they are ready for the reducing bath. This is a solution of sulphate of iron, in proportion of one part iron to nine parts of water, in which the skins must remain until the tannage is complete. After this they are washed and dried in the usual manner. With either or both of the solutions is combined acetic acid in the proportions of one part of acid to sixteen parts of solution. In place of acetic acid, any chemical equivalent may be employed. Instead of pure acetic acid, either vinegar or pyroligneous acid may be used. The proportions of ingredients employed in this method of tanning may be changed; the order of solutions may also be reversed. In place of chromic acid or bichromate of potash in the first bath, other chrome salts may be used, as for example, bichromate of soda, also bichromate of ammonia. While the sulphate of iron is considered the best article to use in the second bath, other iron salts may be substituted.

The acetic acid may be in the pure form, or as contained in vinegar or pyroligneous acid. The employment of the acetic acid is very essential in getting a thoroughly and uniformly tanned leather. It may be used in connection with either of the alternative baths. When it is not used, and the skins are immersed simply in the chromic acid bath and then in the sulphate of iron liquor, to which no acetic acid has been added, the iron salts do not penetrate properly, and the result is a crusty deposit on the leather, and the grain is brittle and hard and the interior is also hard, owing to its being improperly tanned. When acetic acid is used, the penetration of both the chromic and iron salts is uniform throughout the skins, the leather is thoroughly tanned and finished up soft, tough and with a fine smooth grain. Pickled stock, such as pickled sheep, lamb and goat skins, also pickled hides may be tanned in this process in the pickled condition, no drenching being necessary, simply a drumming or soaking in salt water to soften and open them out.

Patented by S. Chadwick, Philadelphia, Pa.

ONE-BATH PROCESS OF CHROME TANNING.

Owing to the many unpleasant features of two-bath tanning, and the difficulties and perplexities and failures met with by inexperienced tanners in using the two-bath liquors, without sufficient knowledge or experience, the one-bath processes of chrome tanning have become very popular. They deserve their popularity, by reason of the simplicity and ease with which leather can be made. There are several one-bath processes that have been introduced, all possessing some merit. The tanning material is sold to the tanner in concentrated form, all ready for use. In a general way these liquors are used in much the same manner as sumac, bark and gambier liquors. When they are applied in paddle vats the skins are entered into a weak liquor, and as they absorb the tanning material contained in it, the strength of the bath is increased until it becomes a fairly strong solution. Any tanner who has had experience with two-bath processes finds the one-bath method exceedingly simple, while those not familiar with chrome tanning, but experienced in bark or sumac tanning, ought to be able to readily understand the new process and to meet with little difficulty in making chrome leather by a one-bath process. While a great deal of the quality of the finished leather depends upon how the skins are tanned, much more depends upon how they are prepared for tanning, and how they are treated after they are tanned, during the processes of currying and finishing. One-bath liquors do not change character with age, and are not injured by frost or exposure. They are clean and free from smell and stain, and can be regulated by the tanner to tan slowly or quickly as he may desire. When applied in vats, the liquors can be used over and over for successive lots of skins, by being strengthened up, and great economy can thus be attained. In two-bath processes the skins are subjected to the action of corrosive materials which often produce damage to the leather.

This is all avoided when one-bath liquors are used, as they are neutral, or nearly so, and free from uncombined acids. The results that follow their use can be easily regulated, and are as a usual thing very uniform and reliable. The mere tanning with these concentrated liquors is a very simple and straightforward process, and little experience is required, provided the skins or hides have been properly prepared in the beam-house. Thorough liming and bating or drenching is necessary in order that they may be soft and pliable to begin with. As chrome leather is usually finished upon the grain, the skins require to be handled in such a manner that the grain is left smooth and strong, and not allowed to become rough, coarse or weak. In order that they may be thoroughly tanned, and no thin strip of raw material left through the center, which would cause the leather to be hard and tinny when dried out, the tanner must use plenty of the tanning material. No harm can come to the skins when they are left in the liquor for a long time, as it is absolutely necessary that they are thoroughly

tanned, which can not be depended upon when they are rushed through the process in the shortest possible time. Some of the one-bath tannages are more astringent than others, and their effect upon the stock is to draw or contract the fibers. When this is liable to occur, common salt should be added to the liquor in the same manner and for the same reason that it is used in conjunction with bark, sumac or gambier liquors,—to hasten the tanning, to keep the skins open and plump, and to prevent the contraction of the fibers. One-bath liquors are used successfully in drums, paddle vats or vats with rockers. They are applicable to hides and skins of all kinds, and for making every kind of leather from kid-glove leather to sole leather. The two-bath processes are sometimes preferred to the one-bath processes in the tanning of goatskins for glazed kid, as they seem to split up the fibers and to produce a finer grain than the single-bath liquors. Yet very good kid leather is made with one-bath processes, with one point in their favor, that the leather so made is plumper than that produced by acid processes, which have no plumping nor filling properties whatever, but leave the skins thin and without plumpness.

TANOLIN (THE MARTIN DENNIS PROCESS).

The best known of all one-bath chrome processes is the Dennis process, called Tanolin. This material is manufactured under patents and sold to tanners outright in barrels, no licenses being required, and no royalties asked for. The use of Tanolin is very general. It is especially adapted to the making of soft, tough leather used in the manufacture of shoes and gloves. Its field of usefulness is not, however, restricted to those branches of the leather trade, but extends to heavy leather for harness, belts, and for any purpose where tough supple leather is required. It must prove interesting to practical tanners to know how this popular tanning material is made. The manufacture of the liquor is covered by patents. According to the patent specifications, a solution of common chloride of chromium is first prepared. This may be done by dissolving the pigment known as chrome green, or the commercial chrome oxide, in commercial hydrochloric acid which has been diluted with an equal bulk of water, care being taken to use more chromic oxide than the acid will take up, in order that the resulting liquor may be as nearly neutral as possible. About eight ounces of the commercial acid are sufficient to dissolve a pound of commercial oxide of chromium. To this solution of chloride of chromium is next added slowly and carefully a solution of a more powerful base, and for this purpose carbonate of sodium, or as it is commonly called, sal soda, is preferred. This is added until rapid effervescence ceases. It usually takes about one-half pound of sal soda crystals to each pound of chrome oxide, dissolved as above. The liquor which results is a solution of basic chloride of chromium. It may be considered as consisting of the normal chloride of chromium and chromic oxide in soluble combination, and a quantity of chloride of sodium or

salt formed by the union of a part of the acid, which was in combination with the chromium, with the sodium base of the carbonate of sodium. This sodium chloride in the liquor serves the very useful purpose of preventing the drawing or contracting of the fibers of the hides or skins that would result were it not present in the solution. To the solution are also added a few pounds of common salt to still further counteract the astringent effects of the chrome liquor. In the two-bath processes of tanning, the chromic acid is presented to the skins in the liquor of the first bath, which usually consists of a solution of bichromate of potash and muriatic acid. The chromic acid in the skins is reduced to chromic oxide by the action of some reducing agent, such as sulphurous acid or sulphuretted hydrogen. Chromic acid is a very powerful oxidizing agent and does more or less injury to the hides or skins. It requires great care and caution to produce with these methods of tanning, leather that does not crack or break nor become hard and brittle after it is dried out. The principle of the Dennis process is to impregnate the hides or skins with the liquor in which the chromic oxide is held as an already reduced salt and not in combination with acids. In practice, the prepared stock is treated to the tanning liquor in drums or paddle-vats; and it is necessary that during the process it be frequently moved about in order that the action of the chromic salt may be uniformly distributed. The length of time consumed in making leather by this process varies according to the thickness of the hides or skins, and ranges from two hours up, depending also upon the method of tanning used, drum tanning being accomplished in much less time than when paddle-vats are used. The tanning is accomplished in one bath; thus considerable labor is saved. The skins are not exposed to the destructive action of chromic acid as in two-bath tanning, and this results in making the leather stronger and not so liable to become papery or weak after it is dried out. There are no offensive or suffocating smells evolved; and there is no danger of allowing the skins to remain in the liquors longer than is really necessary to tan them. The neutrality of the tanning liquor is of great assistance in the currying and finishing of the leather after it is tanned. The hides or skins are prepared for this method of tanning in the manner employed for any tannage, of which softness and smoothness of grain are important qualities. When the stock is tanned and is removed from the tanning bath, there is usually left in the liquor considerable tanning material. This should not be thrown away, but the skins may be put in and they will readily absorb the tanning material from the liquor. A new liquor can then be made and strengthened from time to time. In this way not a drop of the tanning material need be wasted, and the cost of tanning kept at the lowest point. When heavy hides are being tanned, it is good practice to suspend them on rockers in the vats so that the liquor may be gently agitated. If they are split after tanning, it is better to scour them with brush and slicker, or else mill them in a drum, and then return them to the

liquor for at least twenty-four hours longer. Light skins, such as goat, sheep, calf and kangaroo, are preferably tanned in pin-mill drums, as less time is thus consumed than when vats are used. They are tanned in drums in two or three hours. The plumpness of the leather may be increased by first treating the skins to a bath of alum or of sulphate of alumina and salt previous to the tanning in the chrome liquor. Fairly soft water should always be used in making up the tanning bath. Hard water contains lime and magnesia, and these cause the tanning material to be precipitated from the solution and render it unfit for use. When a quantity of the liquor is used in vats for different packs of skins, it is advantageous to correct the liquor by adding to it slowly and carefully a solution of sal soda, one pound of sal soda to three gallons of water. This soda solution should be added until the tan liquor appears cloudy, and its effect is to render the tan liquor so sensitive that it will yield to the skins the whole of the tanning material. Tanolin is made and sold, in both liquid and crystal form, by the Martin Dennis Chrome Tannage Co., Newark, N. J.

PROCESS OF ALUM AND CHROME TANNING.

The following process of chrome tanning produces leather that possesses the good qualities of both alum and chrome leather. In appearance, plumpness, fine grain, softness and feel it resembles the former, and in softness, and because of its insoluble nature, it resembles the latter class of leather. The process consists of three consecutive steps or stages. The first step consists of tawing the skins in a solution of sulphate of alumina and salt. In the second step the sulphate of alumina is fixed upon the fibers of the skins by means of a solution of hyposulphite of soda, and after this has been accomplished another solution of sulphate of alumina and salt is given to the skins, by means of which they are plumped, and the thinness that follows the use of hyposulphite of soda is overcome. When these things have been done they are thoroughly alum-tawed, and if desired they may be taken after the last treatment with alumina and salt and finished without further tanning.

To complete the process and to chrome tan the skins, they are taken after the final application of alumina and salt and given the chrome liquor. In practice the process is carried out as follows: The skins, after drenching and washing, are drained and weighed. For every hundred pounds of stock a solution is prepared, consisting of three pounds of sulphate of alumina and six pounds of salt in three gallons of water, boiled and allowed to cool. In this solution they are drummed for twenty minutes. Then for each hundred pounds of skins in the drum ten pounds of hyposulphite of soda are dissolved in three gallons of water and this liquor is poured into the drum, and drumming continued for fifteen minutes. To finish the first part of the process a third solution is prepared by dissolving in three gallons of water two pounds of sulphate of alumina and three pounds of salt. This is added

to the contents of the drum, and the skins again drummed for thirty minutes or longer, or until they have acquired the requisite degree of plumpness and fullness. They are then taken from the drum and washed lightly by being dipped in clear water, and are then thrown over horses and allowed to press and drain for some hours. The old liquor being drawn off from the drum, the skins are washed off in clear water to remove from them any excess of tawing materials, and are ready to receive the chrome liquor. This is used without the addition of water or acid of any kind. For the chrome tanning from three to six gallons of the concentrated chrome liquor are required, according to the weight of the skins, for each hundred pounds of them. The chrome liquor is prepared as follows: From five to six pounds of chrome alum are dissolved in five gallons of water without the aid of heat. To the solution of chrome alum are added from two and one-half to three pounds of sodium sulphate and from twelve ounces to one pound of potassium or sodium acetate or its chemical equivalent. In a liquor thus prepared the skins are drummed for from thirty minutes to one hour, or until they have taken up all, or nearly all, of the liquor and show thorough penetration of the same. At this point they will be found to be chrome tanned and insoluble in boiling water. The leather may next be taken from the drum and washed and finished in any manner desired in either colors or black, glazed or dull. When thick, heavy skins are being tanned, the quantity of chrome liquor used may be increased to six or seven gallons for each hundred pounds of them. The sodium sulphate is the active agent in the solution, the sodium chloride or common salt being added to prevent merely the tightening or contracting of the fibers. The chloride may be omitted if the quantity of sulphate of sodium is increased by an amount equal to one-half the weight of the chloride, as given in the above formula. In this process no free acids whatever are used. The skins are first tawed with alum and later treated with chromic oxide presented as an already reduced salt. Free acid in the solution, added as an element, that is, other than as produced by the decomposition of the chemicals employed in the presence of the skins, will retard, if not prevent, the reaction necessary to produce leather. For this reason the skins must be entirely free from acid and perfectly neutral when the process is begun. Pickled stock, such as sheep and lamb skins, must be freed from the acid used as a pickle by being drenched in a sour bran and salt drench before they are treated. After the tanning is completed the skins must be allowed to lie in the liquor for some hours, or over night, and then either thrown over horses or laid out flat in piles for twenty-four hours in order to give the tanning material taken up by them time to thoroughly act upon the fibers. After this the leather is washed for twenty minutes in warm borax water, next in clear water for twenty minutes, and then shaved, colored and finished. This process is patented by Geo. W. Adler, Philadelphia, Pa.

ONE-BATH PROCESS.

Another one-bath chrome process for which waterproof qualities are claimed is compounded in the following manner: Twelve pounds of chromic acid are dissolved in about six gallons of hydrochloric acid, the latter having a specific gravity of 1.146 and a hydrometer strength of 28.61. Fifty pounds of crystallized chrome alum are dissolved in about twenty gallons of water, without the aid of heat; and seventy-five pounds of crystallized carbonate of soda are dissolved in about ten gallons of water. These solutions being obtained, the solution of soda is added slowly to the chrome alum solution, the latter being constantly agitated by stirring. When the compound assumes a cloudy appearance, and a fine sparkling mist is seen rising to the top, the addition of the soda solution should be discontinued and sufficient water added to bring the volume up to forty-four gallons. The next step is to thoroughly mix this compound of chrome alum and soda with the dissolved chromic acid before described, gently stirring the mixture while the mixing is going on. Then the combined mixture should be allowed to stand and settle for twenty-four hours. The water in which the tanning is to take place should be heated to eighty degrees Fahr., and to every one hundred gallons of water one and one-half gallons of the concentrated tanning liquor are added, thus making a one and one-half per cent. liquor. The strength of the bath needs to be gradually increased during the treatment of the hides by the regular addition of more chrome liquor, in one-half gallon quantities, until the bath has had from four to five gallons of the concentrated liquor added for every one hundred gallons of water. The heat and strength of the bath should be maintained during the operation, and the hides or skins constantly stirred about. An experienced tanner will have no trouble in telling when the stock is tanned, but a good rule is to watch it carefully, and when the thickest part of the heaviest skin shows a deep greenish-blue appearance all through, the tanning is completed. When it has been seen that the hides or skins are sufficiently tanned, they are removed from the bath and washed in water to which borax has been added, in proportion of one ounce to twenty gallons of water. The time required to tan with this process varies considerably. Sheep-skins usually require about one hour, and goat-skins about one and one-half hours. Calf-skins are tanned in from two to four hours, and hides in about ten hours. Skins tanned by this process are adapted for a great variety of purposes, and especially where waterproof stock is desired, as they are not deteriorated in any way by the treatment, but are left strong and pliable and susceptible of taking a high polish. They may also be tanned in drums. It usually requires about three gallons of liquor, prepared as described, to tan one hundred pounds of skins, weighed after drenching. After tanning, they are treated during the finishing process in the same manner as any chrome-tanned stock. This process is patented by Joseph W. Smith, Girard, Ohio.

A NEW DEPILATORY.

It is well known that sodium sulphide has great depilatory powers, but that hides depilated by it or by a composition which contains it as the preponderating ingredient become dry and brittle after a few months, lose strength rapidly and crack on the grain side, and that the hair removed from hides by treatment with this substance possesses little strength and is of no value. The use of depilatories consisting largely of sodium sulphide is therefore confined mainly to the treatment of sheep pelts and the removal of the wool therefrom. The process here described produces a depilatory composition which can be used in the form of a watery solution, in which the hides are immersed, and which operates quickly and effectively in loosening the hair without injuring either the skin or the hair. This improved composition consists mainly of calcium sulphhydrate and barium hydrate, and contains barium hydrate in excess or as the preponderating ingredient. In preparing this improved composition in the preferred manner mix approximately, by weight, sodium sulphide, six parts; hydrate of calcium, eighteen parts; and commercial hydrate of barium, seventy-six parts. This composition is dissolved in warm water in the proportion of about four pounds of it to ninety-six pounds of warm water. The sodium sulphide combines in the solution with the hydrate of calcium, forming calcium sulphhydrate, so that the solution contains calcium sulphhydrate and hydrate of barium in excess. The calcium sulphhydrate is preferably produced as above described and by the use of sodium sulphide. The hides or skins are immersed in the solution, and within a comparatively short period of time, usually about twenty-four hours, the hair becomes quite loose, so that it can be easily removed upon the beam without injury to skin or hair.

The composition contains barium hydrate in excess or as the preponderating ingredient, and does not dissolve or remove any part of the gelatinous tissue, grain or substance of the hide or dissolve the hair bulbs as sodium sulphide does, but acts mainly by expanding the skin, thereby loosening the hair bulbs so that the hair can be readily removed on the beam. The hide retains its natural suppleness, although increasing somewhat in weight, and the hair retains its natural strength even if the hide is allowed to remain immersed in the solution longer than is necessary to loosen the hair. The hides require no bating or liming after treatment with the solution, and are placed in a very receptive condition for the tanning material. The proportion of sodium sulphide in the composition is so small that this material does not act to any extent as a depilatory, but mainly to freshen and restore the grain and give the skin plumpness. John Campbell and William A. Rushworth, of Chicago, assigns to Schoellkopf, Hartford & Hanna Co., of Buffalo, have patented this composition.

DEPILATING WITH SULPHIDE OF SODIUM AND CHALK.

A mixture of sulphide of sodium and chalk or whiting has been proposed for use in unhairing skins and preparing them for tanning. The process may consist of sulphide of sodium, three parts by weight; chalk or whiting, one part; and water in quantity of eight gallons, more or less. The sulphide of sodium, in quantity about three ordinary bucketfuls, is first dissolved in water to obtain a solution of a strength varying from two to six degrees, Baumé test, the strength varying according to the nature of the hides or skins being treated. The demulcent, chalk or whiting is mixed with water, in quantity about eight gallons to one bucketful of chalk. This mixture is then added to the previously-prepared sodium sulphide solution. The solution with the demulcent in suspension is then introduced into an open vat or vessel provided with means for agitating the same, as for instance a paddle vat.

The hides or skins are introduced into the solution, which is thoroughly agitated for two or three hours. They are permitted to remain at rest in the solution for a comparatively long period, say ten to twelve hours, when the solution is again agitated. During the second agitation the solution is gradually diluted by the addition of fresh water until it contains no matter in solution or suspension, but is substantially free from the same.

By mixing with the sulphide of sodium a demulcent such as chalk or whiting, a liquid compound is provided, by the use of which the caustic nature of the sulphide is diminished and made far less energetic in its action upon the raw hides or skins. By reason of its mild chemical action, the liquor readily softens the gristle, swells the fiber, as well as effects speedy dissolution of such animal matter as it is desirable to remove. Skins treated according to this process are said to be ready for tanning without further manipulation or treatment, and when tanned have fine, smooth grain and firm, plump and mellow feel. Patented by H. Holmes, Philadelphia, Pa.

PROCESS OF DEPILATING IN DRUMS.

This process consists in preparing skins for tanning into leather by means of sulphide of sodium and revolving drums. As will be seen by reading the description, it is a practical method of treating stock and preparing it for leather. By this method of treatment, which is simple, rapid and comparatively inexpensive, the skins of goats and kangaroos, and those of sheep from which the wool has been pulled, pelts and other skins and hides in the hair or raw condition, may be prepared for and delivered to the tanner in a few hours after the process has been commenced. In carrying out the process, a hot solution of sulphide of sodium is prepared. For example, twenty-five pounds of sulphide of sodium are placed in a tank or other suitable vessel and water introduced at a temperature of one hundred degrees Fahr. The resulting

hot solution of sulphide of sodium is put into a drum that may be closely sealed and rotated and more water added, say twenty ordinary pailfuls or forty to fifty gallons. Into this solution in the drum the hides or skins, just as they come from the soaking process, or in the case of sheep-skins after the wool has been removed, are placed. The proportions of sulphide of sodium and water mentioned are enough for twenty dozen skins. This number is placed in a drum with the solution of sulphide of sodium, and after the drum is securely closed drummed therein for two hours. The drum, still closed, may now be permitted to remain at rest for ten or twelve hours, or over night. During this time the stock is excluded from the air and exposed to the solution of sulphide of sodium and to such fumes as arise therefrom. At the end of the stated time the drum is opened and the skins are washed with water, after which they are in condition for the tanner to receive and to tan them by any method of tanning. The stock treated in this manner will be found to be of close firm body, plump and with a fine smooth grain. In some tannages it does not tan so readily as skins prepared in the regular manner, but this can be overcome by the use of strong tanning liquors. The caustic nature of the sulphide of sodium has a more energetic effect upon some goods than upon others. Calf-skins are readily drawn or contracted upon the grain when they are treated to strong solutions of sulphide of sodium. A small quantity of lime mixed with the sulphide liquor assists in getting a smooth fine grain, and to overcome to some extent its drawing tendency. When this method of preparing skins is used the hair is lost, but this loss of hair is made up by the firm solid leather that results. When a soft leather is wanted, the treatment with sulphide of sodium must be followed with a short liming.

This is the Pierson and Moor patented process.

DEPILATING WITH CAUSTIC SODA AND CALCIUM CHLORIDE.

The following process for preparing hides and skins for tanning was invented and patented by the Messrs. John and Edward Pullman, of London, England. It is based upon the use of solutions of caustic soda and calcium chloride, in place of lime, and is intended to do away with the old liming process. It consists of two baths. In the first bath the hides or skins are saturated with caustic soda. This is acted upon by the calcium chloride of the second bath, and the union of the two chemicals forms calcium hydrate or lime and salt in the interior of the hides or skins. The time of preparing the stock is greatly shortened, it being possible to accomplish in four hours what by the old method required ten days. More exact liming is obtained because definite weights of raw stock may be acted upon by previously-determined quantities of caustic soda and calcium chloride. The salts formed in the skins are very soluble and readily removed; and as a consequence less bating and drenching are required than in the older method of

liming. The process may be reversed by first using the bath of calcium chloride and then applying to the skins saturated with the same, the caustic soda solution.

The goods to be treated by this process must first be soaked in a putrid or foul soak. The object of this is to introduce a sort of bacterial action necessary to loosen the hair. After the skins or hides become thoroughly softened in the soak water, they are placed in a drum with a solution of caustic soda, from one to one and one-fourth per cent. of the soda being used. In this solution the stock is treated in the drum for three hours, more or less, according to thickness, and then taken from the drum and allowed to drain for some time, after which it is replaced in the drum with a one and a half per cent. solution of calcium chloride, in which it is drummed for from one-half to one hour.

When vats are used, more time is consumed than when drums are employed. The first bath usually requires forty-eight hours, and the hides or skins are handled two or three times. In the second bath they remain a similar length of time and are also handled once or twice. The unhairing is done in the usual way. The addition of a small quantity of sulphide of sodium to the caustic soda solution causes quicker loosening of the hair. In the case of skins upon which the lime or caustic alkali in solution possesses a deleterious action, they may be submitted to the action of a sufficiently strong solution of the calcium chloride until they are saturated with it, and may then be painted upon the flesh side with the caustic solution, so that by penetration a perfect and intimate liming results without contact with or injury to the fur, hair or wool. This method is necessary in preparing sheep pelts for pulling. When this form of treatment is employed, the strength of the calcium chloride may be about two per cent. and the strength of the caustic soda solution from three-fourths to one per cent.

LIMING PROCESS.

In this process the procedure is as follows : First, the skins are placed in cold water for a period of ninety-six hours, more or less, to draw out the blood and salt ; next they are brought into lime water at about 55 degrees Fahr., the temperature being gradually raised to 80 degrees. In this heated solution they are agitated for twelve hours. The temperature is now reduced very gradually until the solution grows quite cold, the stock being permitted to remain in soak for about four days longer. Third, the skins are now unhaird and fleshed ; fourth, they are placed into cold clean water, where they are thoroughly washed and worked to remove all the lime and other impurities ; fifth, they are placed on the working beam and finally cleaned and prepared for the tanning liquor, and, sixth, they are brought into tan liquor of from 35 degrees to 60 degrees barkometer, in which they remain until tanned.

The skins may be agitated, washed and scrubbed by machinery at

various stages in the process, and hot water may be employed to assist in the removal of impurities.

It is claimed that the time required with this process to tan sole or heavy leather is from twenty-one to thirty days, the time varying in accordance with the hide to be tanned, while a calfskin may be perfectly tanned in from ten to fifteen days. This time may, however, be materially reduced.

In the second step of the process all traces of the glue, oil and other impurities are removed. The importance of this step is evident, as the hide is prepared more effectually for subjection to the tanning agent and renders it more capable of receiving a larger quantity of grease, the resulting leather being plump and pliable, of finer texture and appearance and of increased durability. The inventor of this process claims that time, labor and expense are reduced; the hides are prepared to carry more grease than usual, and they do not become hard and brittle but more pliable and durable and of better grain, finish and appearance than leather produced under older processes. It is said that the best results are obtained by using tanning liquor of high degree. The temperature of the lime solution may be increased to some extent, depending on the hides under treatment, but in all cases the reduction of the temperature should be gradual and extend over a comparatively long period. Patented by Chas. Burkhalter.

DEPILATING WITH LIME AND COPPERAS.

This process is for the purpose of removing hair and grease from hides and skins preparatory to the tanning process and, it is claimed, for improving the quality of the leather to be made.

Mix together in a vessel about eight gallons of water with twenty pounds of lime so that the lime is thoroughly slaked and, as far as possible dissolved. For this purpose use so-called wood-burned lime. In another vessel dissolve ten ounces of sulphate of iron (copperas) in two gallons of water, and add the solution to the lime solution, mixing the same thoroughly together. Next add twenty-five gallons of cold water.

Into the mixture thus prepared and as soon thereafter as possible, place the hides and allow them to remain for a period of time varying from twenty-four hours to sixteen days. They are then removed and are unhaired in the usual way. The variation in the period of time required for treating them in the liquid as described depends upon many factors, the shorter time usually being required when the liquid is freshly prepared.

Preparatory to placing the hides in the liquid they are soaked and milled in the usual way. After treatment by this process they are washed thoroughly. This washing does not take from them any of the valuable material usually lost in washing, so that nothing but dirt is removed.

Hides treated in the manner described, it is claimed, make plumper leather and the latter does not "pipe" with the grain, and its quality is much better than usual, its weight being conserved in a legitimate way, by saving within the fibers certain materials that would otherwise be removed by washing.

Patented by William J. Ward.

IMPROVED PROCESS OF BEAMHOUSE WORK.

This improved method of beamhouse work is being used by some of the largest and most prominent manufacturers of glazed kid and other goatskin leathers. Briefly stated, the process consists in first painting the skins with a thin paste of lime and arsenic and unhairing them after twenty-four hours. They are then treated in a drum with a solution of sulphide of sodium for about twenty-four hours. Without washing, they are next placed in a reel and subjected to the action of a solution of hyposulphite of soda for about twenty-four hours. After this treatment they are placed in a vat containing lime, a little arsenic and water, where they remain two to five days, more or less, after which they are washed, pured, bated, drenched or otherwise treated as may be necessary to prepare them for tanning.

The well-known advantages of sulphide of sodium are secured without any of its undesirable features. Sulphide of sodium swells the skins to their fullest extent, the fibers being differentiated into finer fibrils and the skins thoroughly opened up, and the natural fat converted into a soluble soap, which can be subsequently washed out, and other non-tannable matters removed or so acted upon that they are washed or worked out of the stock by subsequent operations. By following the sulphide treatment with hyposulphite of soda the sulphide is disintegrated, its action upon the stock is arrested and injurious results are prevented. And by the final lime and arsenic treatment the skins are so prepared that they can be readily bated in the usual manner.

This is a much safer process than the one in common use. No old limes, swarming with unknown and dangerous bacteria, are employed. It will therefore be found much more satisfactory, especially in summer weather. The process, taking only about one-half the usual time, requires that only half the amount of stock be in the beamhouse in perishable condition. In case of any interruption to the regular work of the factory this is a great advantage, to say nothing of the time saved. The by-products from stock treated by this process are of equal value to the hair and glue pieces from skins unhaird in the usual way.

The patents covering this process are owned by the International Sulphide Process Company, Camden, N. J.

PROCESS OF LIMING FURS.

The objects of this process are, first, thoroughly to lime furs, hair skins, skins, hides and pelts; second, to reduce largely the time occu-

pied in the process of liming, it being possible to perform it in four hours, whereas ten days have been generally necessary; third, by operating with known weights of skins, definite temperature, strength of the solutions used, and time to produce an exact liming result; fourth, to regulate the amount of salts remaining in the limed skin, for example, calcium carbonate, the unregulated presence of which for the purpose of tanning is undesirable. By this process a hide or skin can be limed and, in the result, be practically free from this salt, while on the other hand, for certain classes of stock this salt is essential for the production of good leather; the desired amount can also be deposited intimately combined with the fiber, while by the process heretofore used this regulation of the amounts of insoluble calcium salts remaining in the fiber, is to almost any degree impossible. Fifth, to prevent waste, as the quantity of lime used in the ordinary method is very considerably in excess of that required, owing chiefly to the action of the carbonic acid gas of the atmosphere converting the soluble hydrated oxide of calcium into the carbonate of calcium; sixth, saving in the processes of bating and purging, because the sodium or other salts used in this process being soluble the greater portion of them can be readily washed away, and consequently a very much smaller quantity of bate is required, and, seventh, a reduction in cost, since there is little or no waste and the salts are recoverable.

The method consists, essentially, in chemically producing calcium hydrate or calcium carbonate in the substance of the skin itself. Instead of treating the stock with these materials externally applied, raw or partially limed furs, hair skins, hides and pelts are acted upon by a weak alkaline solution, caustic soda or caustic potash or the carbonates of such metals, or a mixture of both in any proportion, according to the ultimate degree of liming required, and the subsequent transposition of this is then effected by a solution of chloride of calcium or other salts of calcium so that calcium hydrate or calcium carbonate is produced, and retained and fixed in, and in combination with, the substance of the skin, the remaining soluble alkaline salts being removed by washing.

The process may obviously be reversed, that is to say, the solution of a calcium salt being used first and the caustic or alkaline solutions afterward.

In the case of furs or hair skins, upon which the lime or caustic alkali in solution possesses a deleterious action, submit them first to the action of a sufficiently strong solution of the calcium salts until they are saturated with it, and then paint the caustic or alkaline solution upon the flesh sides, so that by permeation a perfect and intimate liming results without contact with or injury to the fur or hair. These may be dressed in any desired manner. In proceeding according to this modification if calcium chloride and caustic soda were used, the strength of the former would be about two per cent. of calcium chloride and of the latter from three-fourths to one per cent. of caustic soda.

The quantity of lime deposited in the skins by the method above described may be accurately determined and regulated by variations in the strength of the solutions employed. For instance: Take fifteen dozen sheepskins, a considerable portion of the wool of which may have been previously removed in any desired manner, and place them in a revolving drum of about three hundred gallons capacity, making twenty revolutions per minute and containing one hundred and twenty gallons of distilled water of about 95 degrees Fahr. and holding in solution ten pounds of good commercial caustic soda, sodium hydrate (NaOH). Allow these skins to be revolved in the liquor for three hours, after which period they will be swollen or plumped, but without the appearance or characteristics of limed stock, since they do not contain lime beyond the smaller amount naturally present as a constituent of the raw skin. Draw the skins from the drum and allow them to drain for a few minutes. Then place them in the drum, which has been emptied of its previous contents, and in which have been placed fourteen pounds of anhydrous chloride of calcium dissolved in one hundred and twenty gallons of distilled water of 95 degrees Fahr. Allow the drum and its contents to revolve for about half an hour. The skins will now present a totally different appearance and composition identical with the fully limed goods. After completion by copious washings with distilled water, the skins upon assay do not yield sodium hydrate, but calcium hydrate intimately combined with skin matter. This process is the property of John and Edward Pullman, of London, Eng.

METHODS OF USING PATENTED DEPILATORIES.

In addition to sulphide of sodium, used for the purpose of removing hair and wool from the hides and skins and preparing them for tanning, there are on the market patented depilatories. These materials are very satisfactory articles for both wool-pullers and tanners to use, and leather from stock that has been treated with them is characterized by great toughness, pliability and fine, close grain. These depilatories are used upon the various classes of hides and skins in the following manner: The depilatory crystals should first be dissolved into a liquid with boiling water or steam; being a compound, the material is simply reduced with hot water and not allowed to settle, but the whole liquor is used, as the settlings are a most valuable part of the preparation, forming a slight carrying body, which adheres to the skins and will not gum or injure the wool, but on the contrary makes it clean, soft and silky, equal to sweated wool. The strength of the solution should be for salted skins, 12 to 24 degrees Baumé; thin, open wool skins, 14 to 18 degrees; thick, heavy merino and bucks, 18 to 24 degrees; milk lambs, 18 to 24 degrees; used upon goat and kid skins at the same strengths as upon sheep and lamb skins. The strength, however, need never be greater than just sufficient to start the wool or hair; if applied stronger than this no injury results to the skins; the material is merely wasted.

The skins should never be allowed to heat before or after treatment, nor in any stage of the process. Salted or dried stock should be soaked from twenty-four to sixty hours, and after washing and breaking thoroughly, be well drained of water or extracted before painting with depilatory. The wool or hair usually starts in a few hours after painting, and it is well to pull or unhair promptly, say the next day. Milk or young lamb and kid skins on which the depilatory is used full strength should be pulled as soon as the wool or hair starts, and immediately put into clean, cold water and then limed very lightly from six to eighteen hours. All slats, after pulling and unhairing, should be immediately put into cold water, to which some depilatory has been added; in this they are safe for a good while and in no danger of heating, pricking or spoiling. No depilatory-treated skin can be injured so long as it is kept moist and not allowed to dry out or become hard. The first lime can be half renewed for each batch by adding one bucketful of lime for every four hundred skins, and should always be kept clean and sweet and only used once; and the slats may remain in this lime over night, or from twelve to fifteen hours, in warm weather, and from twelve to thirty-six hours in cold weather.

The second lime should be made entirely fresh, using about two buckets of lime to every four hundred skins. The slats can remain in this lime from one to two days in hot weather, and two to four days in cold weather, when they will be sufficiently limed for ordinary purposes. If they are to be tanned without pickling, a little more lime may be necessary and will do no harm; if high-limed stock is desired, a third, and even a fourth lime may be used. It will be found advantageous to pull the slats out daily while liming in case still limes are used, and it should always be borne in mind that the stronger the solution of depilatory is, and the less it is washed out before liming, the weaker and less liming are required. After the skins are taken out of the lime vats, they should be washed in clean, cold water and are then ready for fleshing or the drench, out of which, work on the grain side and trim, putting them again into clean water as fast as worked, and from this water flesh them well on the beams or machine.

In the treatment of light hair skins, such as goat and kangaroo skins, when it is not desired to save the hair, they can be soaked and softened, and then put into a liquor made up of from ten to fifteen pounds of depilatory to every one hundred gallons of water in the vat. The depilatory should all be dissolved and the liquor well stirred up before the stock is put in. Keeping the skins in a solution prepared in this manner for twenty-four hours, with occasional stirring about, results in reducing the hair to pulp, which can be easily removed by washing for a few minutes in clean cold water. The mixing of lime with the depilatory is not recommended, as the stock is not quite so soft as when the depilatory is used alone. In case dry skins do not get thoroughly soaked and softened before they are put into the solution of depilatory, they may remain in the liquor from twenty-four to forty-eight hours,

according to their condition and the strength of the liquor until they are thoroughly soft and plump. No lime should be applied until they are completely softened. After they are washed to remove the dissolved hair, they may be lightly limed for a few days, and then fleshed and drenched.

If it is desired to save the hair, the skins should be soaked in the usual way and then the water extracted by means of a hydro-extractor, or by the skins draining thoroughly. They may then be painted with the solution of depilatory, at a strength of eighteen degrees Baumé. Each skin is then folded up, flesh side in, and allowed to lie until the next day, when the hair may be easily rubbed off; the skins are washed and limed for a few days. Any one of the well-known methods of drenching after liming may be used. Manures are disagreeable and somewhat risky. Lactic acid and some of the chemical bates are safe and cheap. Bran may also be used with good results when it is properly applied. For the finer grades of stock it is sometimes necessary to work it thoroughly upon the grain after drenching to remove all lime and impurities and then to wash it in warm water, when it will be ready for pickling or tanning. It is always good practice to handle the skins promptly and to allow no delay to take place between the operations, especially in hot weather. The limes should be kept sweet and clean and the stock handled frequently and carefully drenched, as it is during these processes that the character of the leather is made.

When the New XXX Depilatory is used upon hides intended for sole leather, the unhairing should take place as promptly as possible and in such a manner as not to affect the weight of the stock, nor to remove substances and impair the strength of the leather. The usual method employed is, after the hide is soaked, it is spread out on a smooth surface, hair uppermost. If no value is placed on the hair, the hair side is painted with depilatory, used either clear or mixed with lime, well-slaked lime, three parts, depilatory liquor about eighteen degrees strength, one part. The lime should be well slaked, and the depilatory crystals dissolved before being mixed. To apply the same, a vegetable fiber or tampico brush or swab made of burlap or bagging may be used.

After the mixture has been applied evenly over the hide, it should be doubled up carefully and covered up so as to exclude the air and prevent the drying of the paste. If the hair is to be saved, the flesh side should be painted and the hair kept clean. The hides should be kept in a cool, damp place until the hair starts, then opened out, washed in clean cold water and unhaired; then fleshed and the grain worked and washed when they are ready for tanning.

The unhairing can be done another way. A vat is filled with water, and from one-half to three-fourths lime, and one-fourth to one-half dissolved depilatory liquor, eighteen or twenty degrees strength, added thereto and well mixed. Then the hides are thrown in and left in the liquor over night or from one day until the next. The use of lime is not necessary; a liquor of nothing but depilatory crystals of a strength

of from five to ten degrees Baumé may be used. In this the hides may remain until they are thoroughly soft and the hair comes off readily. All tanning operations are the same as for sweated or limed stock, except that slightly stronger liquors are required. It must be mentioned here that only hides intended for heavy leather should be treated in the above manner. The hair is lost, but this loss is more than made up by the extra quality and increased weight gained in the leather, the superior fine close grain, exceeding toughness and pliability and great saving of time and labor.

For upper, belting, harness, enameled and patent leathers, also calfskins, the hides or skins may be painted on the grain or flesh side and washed or unhaired as soon as the hair becomes loosened, which will be in from twelve to twenty-four hours, depending upon the thickness and condition of the stock, and the temperature and strength of the depilatory liquor. If no value is placed upon the hair, the vat method may be used. When it is desired to save the hair it should be promptly and well washed and spread out to dry as soon as convenient after being taken off. Dry foreign hides, kips, etc., must be brought to natural condition of softness by thorough soaking in water, fulling and stretching. This work can be greatly hastened and facilitated by dissolving and adding to the soaks about one-eighth of an ounce of depilatory for each hide or skin to be soaked.

By painting the hides or skins as has been described, and after unhairing, a further liming or swelling may be considered necessary for easier fleshing, scraping, beaming or splitting. This can be done by means of depilatory water alone, which can be made new, or the water the painted hides have been washed in after unhairing can be saved for the purpose, or weak clean limes, as for goat and sheep-skins, can be used. But in any case the liquor should be well stirred and mixed before the hides are put in. The strength of the liquor can be reduced or increased as circumstances require. The proportion of depilatory necessary for liming and swelling purposes is about one to one and one-half ounces for each hide; one-half to three-fourths of an ounce for each kip; and one-fourth to three-eighths of an ounce for each calfskin. If the water is hard, a little more may be used. The swelling and liming are usually completed in from one to four days, depending upon the nature and condition of the hides or skins, the strength of the liquor and the weather and temperature of the limes.

All stock intended for splitting after unhairing, can be plumped or swelled much better with depilatory water, or with clean, well-slaked lime with depilatory water added, from one-fourth to three ounces of depilatory for each hide, depending on size and thickness. It will require from one to five days. The tanner must use his judgment as to these matters, and if the right results are not obtained on first trial, something has been done wrong. It is also important that the hides or skins be opened out, examined and handled daily; the scraping, fleshing and shaving can be done immediately after unhairing or after

swelling. Any stray hairs that may remain can easily be removed when cleaning the grain after swelling. A thorough cleaning of the grain is generally superfluous, it being usually smooth and clean, as nothing touches it to make it unclean. A slight washing in warm water is sufficient to cause the stray hairs to come off. For some kinds of stock a bran drench will tend to soften and improve the grain.

If no value is placed on the hair, the painting of hides, kips, calfskins and other skins intended for tough upper leather may be dispensed with, and no lime need be used. From twelve to forty-eight ounces of depilatory dissolved and added to every fifteen gallons of water in the vat, may be used. According to the strength of this liquor the hides or skins will unhair in two or three days and will be sufficiently swelled to be fleshed, beamed and split. The time can be increased or shortened by using more or less depilatory in the water. The glue stock obtained is just as valuable as from limed or sweated hides, but should be limed before it is used.

The unequal thickness of horse-hides makes them particularly difficult to unhair and swell sufficiently for splitting, and to overcome this a depilatory liquor of eighteen degrees Bé. may be used on the fore part, and a liquor of twenty-four degrees upon the hind part, used either clear or mixed with lime. After unhairing, the hides may be limed for a few days in weak clean limes, the length of time of liming being reduced fully one-half. The subsequent treatment is the same as usually employed. Hog and alligator skins are limed and treated in the same manner as horse and other hides. Patented depilatories are made and sold by Messrs. Stone, Timlow & Co., of New York City.

BATING WITH BICHROMATE OF POTASH.

The gist of this process lies in the employment of a chromium compound as a base, a solution of it forming the main ingredient of the bate, but it is not essential that the latter should consist exclusively of such a solution.

Prepare a saturated solution of two ounces of bichromate of potash in water, pour it into a vat containing one thousand gallons of water and stir the liquor thoroughly. The quantity named is sufficient for the treatment of from twenty to forty hides.

The liquor having been stirred as described, the unhaired hides are thrown into it and left therein for about twenty-four hours, being moved about occasionally so as to secure a uniform action of the bate. The chromium compound will mix with the lime, and by its action it will cause it to be more readily washed out, it being understood that the hides are washed or cleaned as usual at the termination of the bating process, and then are put into the tanning liquor.

In practical work the bate is used in the following manner: After unhairing, the hides are washed in a wash-wheel. A vat is then filled with the quantity of water required, after which the bate-wheel is started

up and the liquor warmed up with steam to 80 degrees Fahr. While the water is getting warm the necessary amount of bate is dissolved in hot water and poured into the bate vat. The hides are then run in the liquor for a short time and left in it over night or longer, depending upon their condition. They are then fine-haired, again washed in warm water and are ready to be tanned. About two ounces of the bate are used for two thousand pounds of green salted hides. Bichromate of potash as a bate has been patented by Henry Schlegel, of Lapeer, Mich.

BATING WITH DILUTE MURIATIC ACID.

It has been discovered that skins coming from the lime after undergoing the usual washing and fleshing can be put into suitable condition for immersion in the tan liquor without resorting to bating, reducing, drenching or purging as is now commonly employed.

The elimination of the lime or alkali, the "letting out" or "opening up" of the skins to overcome the shrinking effect of the lime, the smoothing and "letting down" of the grain, the starting of the gelatinous substance in the skin and regulating its loss, the opening of the texture of the hide from its swollen gelatinous condition are all effectively accomplished by treatment with a suitable acid and salt solution, applied as hereinafter specified. After treatment the solution remaining in the hide acts upon it practically by what is known as "horsing" the hides. A perceptible change in the hide or skin will be noticed during the next twelve to forty-eight hours, and in this state they may be kept for a number of days without injury and ready for immersion in the actual tanning bath. At the first glance at this state of the hides they may appear somewhat similar to stock immersed in an ordinary pickle; but the differences are very marked in the quality of the skin before immersion in the tanning liquor.

The skins, after being unhaired, washed and fleshed, are placed in an aqueous solution containing from one to five per cent. of chloride of sodium and one-tenth of one per cent. of commercial muriatic acid. After a period of from one to two hours it will be found that almost all acid reaction has disappeared, and at this time another one-tenth of one per cent. of muriatic acid is to be added. After a further period of from one to two hours the acid reaction becomes very weak, and thus again one-tenth of one per cent. of muriatic acid is to be added. If the acid reaction should cease inside of two hours (the test to be made by the use of litmus paper or other indicator) another one-tenth of one per cent. of muriatic acid should be added; but if the acid reaction has not disappeared within two hours no further acid should be added.

The treatment can be carried on successfully at a degree of temperature as low as 3 degrees Centigrade (37.4 degrees Fahr.) and again as high as 40 degrees Centigrade (104 degrees Fahr.), the degree of temperature being determined by the nature of the stock and the effect

on the grain, as different skins act differently under the same treatment. Thus the softer-natured skins, such as those of sheep and colts, require a lower temperature, and the harder skins, such as those of goats, permitting a higher temperature. The test as is understood by tanners, is to be determined by the feel of the grain, whether it is smooth or not and by general appearances. The acid is used in such quantities and qualities only at a time that it will act to combine with the lime, but will not to any extent with the substance of the hides. The affinity between the lime and the acid being greater than that between the acid and hide substance, the treatment renders it possible to remove the lime without causing the acid to combine to any extent with the hide substance, and thus leave the hide in its natural condition. The salt is to be used in such quantities only as to overcome the swelling action of the acid, and also for the purpose of preventing too rapid action of the acid.

An important part of this process consists in the discovery that the specific gravity (to be regulated by the amount of salt in the solution) in which the skins are to be immersed before treatment with the tanning solution should be substantially the same as the specific gravity of the tanning bath. By having these specific gravities coincide or nearly coincide there is little or no formation of strong currents of diffusion inside of the skins after they are removed from the salt and acid bath and immersed in the tanning bath, and thus there is no undesirable effect produced upon the texture of the hides, and consequently upon the ultimate texture of the leather produced therefrom.

In processes of drum tanning as applied to heavy hides it not infrequently happens that the strong liquor used and the rapidity with which the tanning is done results in injury to the quality and texture of the leather as well as producing a hard grain. The graining that results from drum processes has always been one of the chief objections to such methods. Experience generally teaches a tanner that it is necessary to start the tanning in vats with weak liquors, then to use a drum process, and perhaps as a final tannage to place the hides again in vats. Extremely strong tanning liquors applied directly to skins coming from the beamhouse always produce inferior leather as regards feel, texture, weight and appearance. This process is the invention of Arnold H. Peter, of New York.

BATING WITH EXCREMENTITIOUS SUBSTANCE AND SULPHUR.

The following example will serve to show the best way of practicing this invention. There is first prepared a mixture of an excrementitious substance with sulphur in order to insure the presence of the sulphur from the beginning of putrefaction. To about one hundred pounds of dry excrementitious substance five pounds of flowers of sulphur are added and the two are mixed together. Sufficient water is then added to form a semi-liquid paste. By this means the presence of the sul-

phur from the beginning of the resulting putrefaction of the excrementitious substance is insured, so that the resulting products and compounds of the putrefaction are presented in their nascent state to the sulphur from the commencement and thereafter throughout the operation of the process.

The mixture is then allowed to stand until the required extent and character of putrefaction has been developed. An aqueous bath is then prepared of the usual volume, say in the ratio of about three pounds of water to one pound of the hides treated. Into this bath is introduced a proportion of the said mixture of putrefying excrementitious matter, sulphur and resulting compounds in the ratio of ten per cent. of such mixture estimated on the weight of the stock to be treated. The hides are then put into this bath, the temperature of which is maintained at about 100 degrees Fahr., until the required effect has been produced upon them, when they may be withdrawn. The proportion of sulphur to be employed may vary somewhat according to circumstances; but it is preferable that the quantity shall be such as to insure at all times during the continuance of the process the presence of an excess of that agent.

While the preferred method of utilizing the sulphur is that which has been described, it will nevertheless be understood that the advantages of this process may be realized, though less comprehensively, by introducing the sulphur separately into the bath after the putrefying excrementitious matter has been charged therein, care being taken, however, to secure as intimate a mixture of such sulphur therewith as possible.

The requisite strength of the bath may for successive charges be maintained by adding, say, an additional two per cent. of the said mixture of putrefying excrementitious substances and sulphur, estimated on the weight of each new charge of hides introduced, thus making it practicable to use the same bath continuously for a number of lots of hides.

This process is patented by its inventor.

BATING WITH SULPHURIC ACID, GLAUBER'S SALT AND BORAX.

A process of bating by the use of a compound solution of sulphuric acid, borax and Glauber's salt has also been made the subject of a patent. In applying this process, the hides or skins, after liming, are placed in a vat or other suitable apparatus containing a solution of three pounds of sulphuric acid, three pounds of borax and three pounds of Glauber's salt, these ingredients being thoroughly mixed with about five or six barrells of water, or sufficient water to cover one hundred and fifty hides or skins. After being placed in this solution, if they are not agitated in any manner, the hides or skins should remain in it about thirty-six hours, but if the solution and the hides or skins are in a tank provided with a wheel for stirring, then about five hours will be sufficient for the action of the solution.

After the treatment of the hides in the solution above described, they are placed for a second treatment in an ordinary bark liquor, to which are added about three pounds of muriatic acid, and about fifty pounds of common salt. The quantity of bark liquor to which the above ingredients are added is about one thousand gallons of six degrees Bé. The addition of the muriatic acid and salt serves to precipitate all foreign substances in the bark liquor, and to prevent any fermentation thereof, and the action of the ingredients in the solution so formed is to soften and render the hides soaked therein more plump.

This method of treatment in a solution of water, sulphuric acid, borax and Glauber's salt for neutralizing the lime in the hides may be practiced without treating them to the solution of bark liquor, muriatic acid and salt; they may also be treated to the action of the latter solution without submitting them to the action of the first named liquor for the purpose of neutralizing the lime. N. Wilson, Becket, Mass., has patented the above process.

BATING WITH HYPOSULPHITE OF SODA, ACID AND SALT.

After the hides or skins have been thoroughly washed and as much of the lime removed from them as is possible, a further treatment is necessary in order to more completely prepare them for tanning and to produce a superior leather. To accomplish this object in a simple manner and without injury to the hides or skins a solution of about two hundred and fifty gallons of water, one hundred and fifty pounds of common salt, three pounds of hyposulphite of soda and three pounds of either sulphuric or muriatic acid is used. About two hundred calfskins and about fifty hides can be agitated in this solution for about two hours. After this they are processed in a second solution composed of two hundred gallons of water, ten pounds of Glauber's salt and sixty pounds of hyposulphite of soda or the same quantity of sodium sulphite crystals. In this solution they should be stirred about for two hours or longer, after which they are ready for the process of tanning. The above solutions can be used for a long time, as they do not ferment or decompose. They only require strengthening proportionately, as they become weakened, by the addition of the same ingredients. The ingredients of both solutions can be combined in one with good results.

BATING WITH TURKEY-RED OIL AND SAL AMMONIAC.

This process is for the purpose of freeing hides and skins from lime, softening, purifying and swelling them after they have been removed from the lime vat and have been unhaired. By this process they are fitted to receive and absorb tanning materials. It consists in subjecting the limed hides or skins to the action of a bath consisting of a mixture of neutralized sulfoleic acids, such as sulforicinoleate of sodium, commonly known as turkey-red oil, with sal ammoniac or ammonium chloride.

The lime in the skins is converted into soluble salts of chloride, at the same time decomposing the sulfoleic acid or the sulforicinoleic-acid salt forming calcium chloride and free fat acid. The fat acid is nearly all absorbed by the hides or skins, thus filling the interstitial cells previously occupied by the lime and the result is soft, porous, swelled and purified hides or skins, well adapted to absorb the tanning material subsequently employed.

By neutralized sulfoleic acid and sulforicinoleic acid hereinbefore mentioned are meant products resulting from treatment of non-drying vegetable oils or fats, sometimes called "triglycerids," such as castor oil, cotton seed oil, arachis (peanut) oil, corn oil, etc., with strong sulphuric acid. The resulting products after being washed to free them from free sulphuric acid are finally neutralized with potassium or sodium hydrate or ammonia, by which means sulfoleates of the bases potassium, sodium or ammonium are produced.

A general formula answering the purpose may be used as follows: one hundred parts by weight of castor oil; thirty to fifty parts by weight of sulphuric acid, 66 degrees Baumé. Agitate thoroughly in a lead-lined vessel and let stand over night. Then draw off the subnatant liquor, which contains the excess of sulphuric acid, and wash the sulforicinoleic acid which floats on the top with a saturated solution of brine, sodium chloride (NaCl) or a saturated solution of Glauber's salt, sodium sulfate (Na_2SO_4). Wash twice with either of these saturated solutions and nearly neutralize the ricinoleic acid with sodium hydrate (NaHA); then completely neutralize with ammonia (NH_3).

In the above formula for castor oil may be substituted olive oil, corn oil, cotton seed oil, arachis (peanut) oil, etc., in the same quantity with similar effect. The resulting product should show a slightly alkaline reaction and should be soluble in water without the appearance of grease floating on the top and, if not perfectly clear, should show at least a perfectly clear emulsion that will not separate when diluted with hot water on standing awhile.

The object of this process is to free from lime, purify, cleanse, soften and swell the hides and skins by the employment of soluble oil, thus dispensing with the use of manure, bran, etc., as at present employed for the purpose of bating.

After the hides or skins have been limed, fleshed and washed they are treated with this bating process to be freed from lime, softened, swelled, purified and made ready for the tanning operations. When they have arrived at this stage, they are introduced into a bath composed of a mixture of sulforicinoleate of sodium and an ammonium salt, preferably sal-ammoniac. The bate bath is as follows: For two thousand pounds of limed hides or skins, use a vat or a semicylindrical vat or a revolving mill, such as is commonly employed by tanners, and run into it approximately about seven hundred and fifty gallons of water, to which add twenty pounds of sulforicinoleate of sodium, commonly known as Turkey-red oil or soluble oil, and ten pounds of chloride of

ammonium (sal ammoniac). Then raise the temperature of the bath to about from 105 to 115 degrees Fahr., and introduce the limed hides or skins.

In practice it is found that about one per cent. of the weight of the skins of sulforicinoleate of sodium (Turkey-red oil) mixed with about one-half of one per cent. of the weight of the skins of sal ammoniac, when diluted with water enough to cover the stock and raised to the temperature above stated, will rapidly effect the decomposition and conversion of the lime contained in the hides or skins into soluble lime solution or calcium chloride. Coincidentally the fatty acid of the soluble oil is set free and is absorbed in such a manner by the skins as to swell and make them porous and at the same time neutralize any adhering lime that may remain in the cellular tissues that may not have been acted upon by the free ammonium chloride in the bath. After the limed hides or skins have been introduced into the bath they must be paddled or stirred about or drummed in the usual manner for about one hour, although they will not be injured by being left in the bath for a longer period of time.

Generally they are kept in the bath until they are in a soft and rag-like condition, which the experienced tanner will readily recognize.

It is not necessary to treat them at the exact temperature of 105 to 115 degrees Fahr. A cold bath may be used but a longer duration of time is required. To expedite the process 105 degrees to 115 degrees Fahr. has been found to be a desirable temperature. After the skins are sufficiently reduced and free from lime they may be placed in the tanning liquors immediately after being purified by this process. The bate bath can be used continuously for some time by adding fresh, but less, material as the bath increases in age and strength. This process, it is claimed, can be used for freeing from lime and for purifying, cleansing, and swelling stock of every description, the same retaining its natural fiber and strength, and after passing through the subsequent tanning operations, the resultant leather is stronger and superior in quality to that bated by dung fermentation processes.

BATING WITH PANCREATIC EXTRACT.

For bating hides, that is to say, for removing the lime and fatty matter from them after the liming process, dog manure has been used for a long time.

The invention here referred to has for its object to provide a simpler and more reliable method for removing the lime, together with the fatty matter and the remnant of the hairs. For this purpose treat the hides with an aqueous extract from the pancreas of animals. The principal constituent of the pancreatic extract is trypsin, the effect of which is materially assisted by the other enzyme of the pancreas, viz., steapsin, which has the property of splitting up fat and completing the saponification of the fat contained in the hides. Aqueous pancreatic extracts alone

have a very efficient bating action, but it is advantageous to add salts of ammonia or of alkalies or mixtures of such salts. The favorable effect of these salts on hides becomes apparent chiefly by the fact that they shrink, become thinner and are less liable to become rough on being placed in pure water after the bating process, which defect is liable to occur when they have a strong alkaline reaction and the water contains a considerable quantity of calcium bicarbonate.

The details of procedure will appear from the following example: A pancreas weighing about 250 grams is extracted with 1 liter of water, and 10 cubic centimeters of this extract are added to 990 cubic centimeters of a 0.1 per cent. aqueous solution of ammonium chloride. The solution thus obtained is an excellent bate.

When the hides, which have been limed and have an alkaline reaction, are introduced into the bating liquid they are liable to become rough through the precipitation of calcium carbonate, in case the water employed contains much calcium bicarbonate in solution. This defect may occur whether the bating liquid contains trypsin alone or together with salts of ammonia or alkali, and it may be avoided by subjecting the water intended for the preparation of the bate to a preliminary treatment, which consists in precipitating the carbonic acid by means of a suitable quantity of lime water, or in adding to the bating liquid before the introduction of the hides starch-paste or other organic or inorganic materials adapted to envelop the calcium carbonate. If desired, both lime water and starch-paste may at the same time be used. Patented by Otto Rohm.

BATING WITH GLUCOSE, SULPHUR AND YEAST.

In working with the Oakes' process, the hides or skins are washed, limed, unhaired and washed again. A bath is now prepared at a temperature of 95 to 100 degrees Fahr., consisting of five per cent. of glucose syrup and one per cent. of sulphur, computed on the weight of the skins or hides, and about one pound of yeast for every thousand pounds treated. Having prepared the bath in this manner, it is allowed to stand about twenty-four hours to become thoroughly fermented. At the end of this time the temperature is raised to 100 degrees Fahr. and the hides or skins are put into the bath.

In order to have a continuous bath, one-half the original amount of sulphur, glucose and yeast are added at the same time. In working this process it is not necessary to keep the skins in constant motion, but only to move them from time to time in order to secure uniformity of action, once an hour being sufficient. By this method of treatment heavy bull or cow hides will be free from lime and in a soft and open condition at the end of eight hours, while lighter skins will require a proportionately shorter period.

On removing the pack the temperature of the bath may be raised, and after introducing one-half the original quantity of sulphur, glucose

and yeast, another pack may be treated, thus making it possible to work two packs each day in the same vat if desired. It will be understood that a continuous bath would in time become too concentrated from solutions of calcium compounds, and thus prevent or retard fermentation. This difficulty, however, is obviated by drawing off half of the solution each and every time after treatment of the second pack.

The hides or skins, as they are removed from the bath, show no trace of lime. They are soft and open and have a smooth, silky grain. As there is nothing in this treatment to cause putrefaction, there is no loss of hide substance, and furthermore, as all of the lime has been neutralized, the goods do not require a drench or pickle, but after washing are ready for the tan, regardless whether it be vegetable or mineral in character. This is the Oakes patented process of bating hides and skins.

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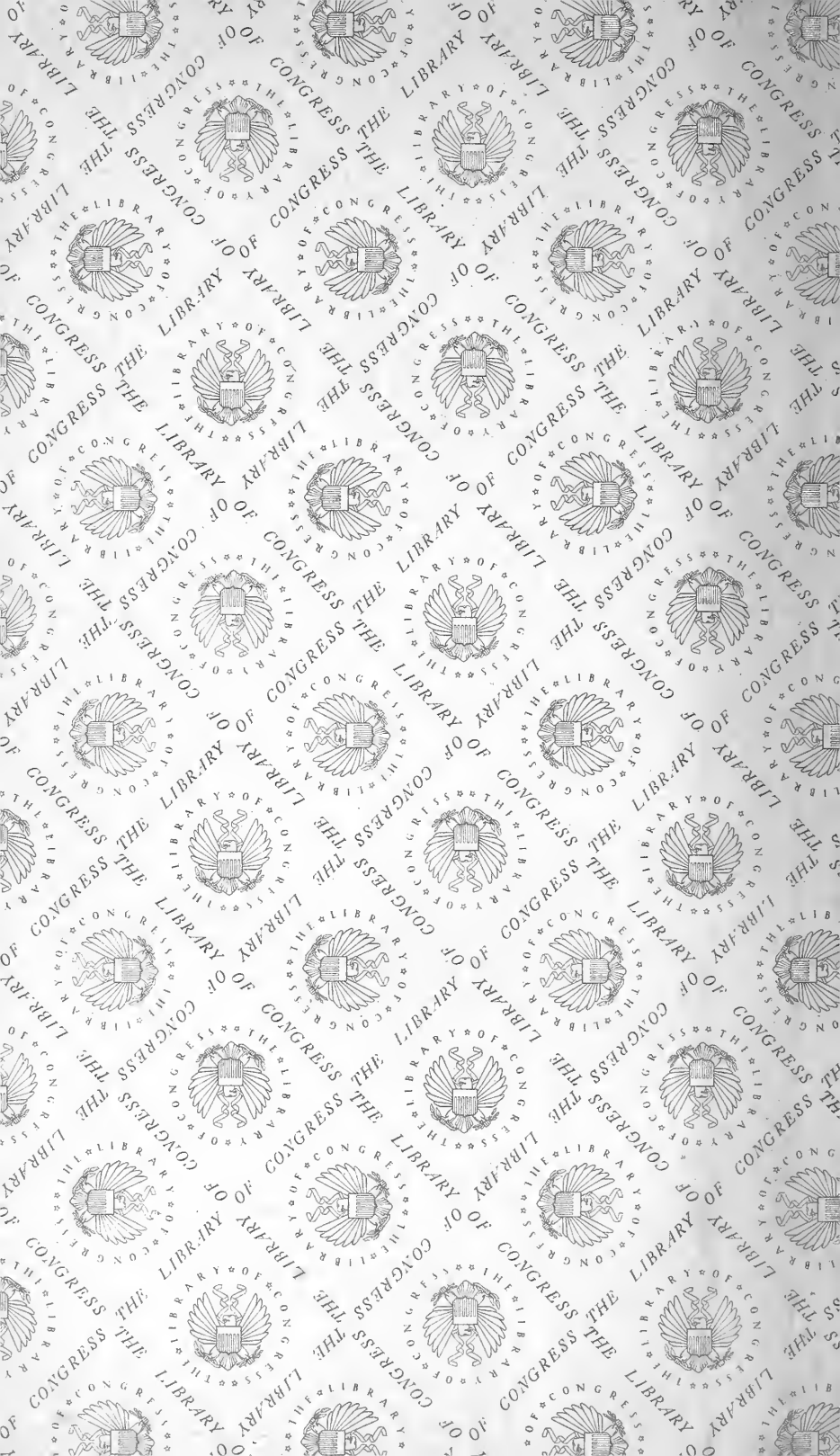
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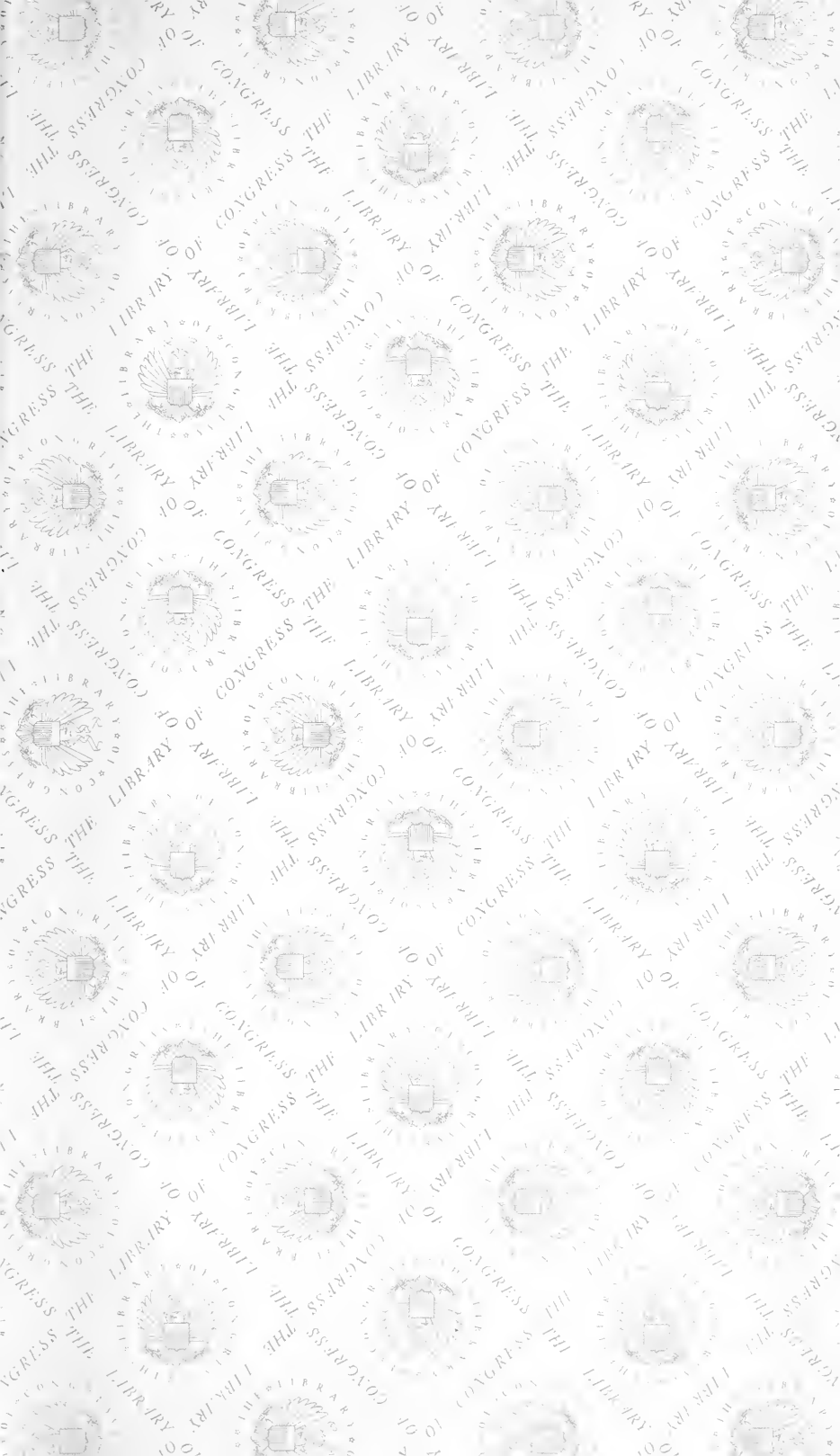
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